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THE UNIVERSITY OF KANSAS
SCIENCE BULLETIN

VOL. XXXIV, PT. I] OCTOBER 1, 1951 [NO. 1

A Brief Review of the Snakes of Costa Rica

BY

EDWARD H. TAYLOR

ABSTRACT: The snakes of Costa Rica are reviewed, largely on the basis a collection made by the author in Costa Rica in 1947. Synopses of all known species are given and keys are added. The fauna as listed consists of 56 genera, and 132 species and subspecies are recognized. The following forms are described as new; *Nothopsis torresi, Dipsas costaricensis, Pliocercus annellatus, Micrurus pachecoi, and Micrurus alleni richardi.*

INTRODUCTION

Early in June, 1947, at the instigation of Professor Reubén Torres Rojas, of Cartago, Costa Rica, I received an invitation from the Rector of the National University of Costa Rica to spend the summer of 1947 studying the herpetological faunas in that country. The welcome invitation was promptly accepted and after hasty preparations, I was ready to leave for Costa Rica on June 18. I was joined at this time by Richard C. Taylor, likewise bent on making a herpetological collection in Costa Rica. After an uneventful air journey we arrived on June 21. Three days were involved in getting the equipment through customs and in obtaining the required permits. The first day of collecting was June 24.

From this date until September 7, the greater part of the time was spent in the field. Faunas of four principal areas were sampled. These were: Turrialba and its immediate surroundings, in the eastern part of the plateau region; Isla Bonita, on the eastern slope of Volcán Poás; the summit and western slopes of Cerro de la Muerte; and Los Diamantes, in the eastern lowlands. A few other localities were visited for shorter periods and of course less representative collections were obtained than were taken in the aforementioned places.

Considerable rain fell during these months, hampering collecting and causing the loss of many man-hours to the collecting work. The journey to the Pacific lowlands on the west slope of Cerro de la Muerte was a pleasant exception. However, due to the fact that this region was dry, collecting was poorer than in other localities visited.

The night collecting everywhere was especially profitable, and a part of practically every night provided its increment to the collection. Collecting at high elevation on Mt. Irazú and Cerro de la Muerte was hampered considerably by fog and rain coupled with the low temperatures of these high peaks. Aside from driving the animals under cover, it likewise did much to render the collector inactive.

While the greatest number of novelties is present in the amphibian collection, certain forms among the snakes seem to merit new designations, and they are given herein.

The collection of snakes from the four principal areas are as follows. The number of species, in a measure, represents the length of time spent in collecting in each place.

Turrialba and surroundings

Constrictor constrictor imperator
Nothopsis torresi sp. nov.
Geophis hoffmanni
Geophis dolichocephala
Xenodon bertholdi
Dipsas costaricensis sp. nov.
Pliocercus annellatus sp. nov.
Rhadinaea d. decorata
Drymarchon corais melanurus
Drymobius m. margaritiferus
Drymobius rhombifer
Pseustes shropshirei
Pseustes poecilonotus chrysobronchus
Spilotes p. pullatus
Erythrolamprus bizonus
Leptodeira a. annulata
Imantodes cenchoa semifasciatus
Tantilla shistosa
Tantilla annulata
Micrurus nigrocinctus mosquitensis
Micrurus mipartitus multifasciatus
Bothrops n. nummifer
Bothrops schlegelii (nigroadspersus)
Bothrops lansbergii

Isla Bonita, Volcán Poás

Ninia oxynota
Dipsas annulata
Chironius carinatus
Chironius grandisquamis
Lampropeltis doliata micropholis
Leimadophis taeniurus juvenilis
Imantodes cenchoa semifascitatus
Imantodes inornatus
Clelia c. clelia
Bothrops picadoi
Bothrops lateralis

San Isidro El General

Geophis hoffmanni
Lampropeltis doliata micropholis
Coniophanes fissidens punctigulgaris
Dryadophis melanolomus alternatus
Clelia petolarius
Xenodon colubrinus

(Boquete camp)

Bothrops n. nigrovirdis
Micrurus n. nigrocinctus
Ninia maculata

Los Diamantes

Ninia tessellata
Trimetopon pliolepis
Enulius sclateri
Leptodeira a. annulata
Oxybelis brevirostris
Coniophanes fissidens punctigularis
Micrurus alleni richardi sp. nov.
Micrurus nigrocinctus mosquitensis
Bothrops atrox

Miscellaneous Localities

Peralta, 300 m.

Thalerophis depressirostris

Cervantes

Ninia maculata

Cartago

Thamnophis sirtalis chalceus

Santa Cruz on Volcán Turrialba, 6500 ft.

Bothrops lateralis
Geophis brachycephala
Geophis hoffmanni

PLAN OF WORK

One of the anticipated results of my acceptance of the invitation to study in Costa Rica was the preparation of a work that might present my findings, and at the same time serve as a primary text for study and identification of the Costa Rican herpetological fauna. No such work, purporting to fill such a purpose, has been prepared for that country. The works of Dr. C. Picado (1931) and Señor Carlos Viquez (1935, 1941) have dealt with only a limited part of the snake fauna. The older work of Cope in 1875 listed the known fauna but many species appear merely as names.

In consequence I have included for each species and subspecies, regarded as having a valid place in the Costa Rican faunal list, a description of an individual specimen or a brief description drawn from the scattered literature. Keys are added to assist in identification. No attempt is made to include an exhaustive treatment of

synonymies. Usually the earliest reference is recorded and one or more others giving a report of the species in Costa Rica.

I contemplate the preparation of two other papers, one dealing with the remaining reptiles (crocodilians, turtles and lizards) and the other treating of the amphibians. Already certain short papers have appeared describing new frogs, salamanders, and lizards.

The half-tone illustrations presented are from photographs made from preserved specimens submerged in water. The drawings are the work of Miss Thespa Stapoulis.

This study is based primarily on two lots of Costa Rican snakes now in the Museum of Natural History of the University of Kansas. The first is that obtained by the Hall, Camp and Westman Costa Rican Expedition of 1947. The second is that obtained by me either by gift, purchase or collecting the same year. I have also had at hand the collection made by Richard C. Taylor who has allowed me the privilege of studying it. I have had access to most of the snakes from Costa Rica now in the Museum of Comparative Zoology, Harvard College, and those in the United States National Museum of Washington, at which institutions I spent some time in the summers of 1948 and 1949. I have likewise found occasion to examine certain specimens in the Museum of Zoology University of Michigan, Chicago Natural History Museum, The Academy of Natural Sciences of Philadelphia and The American Museum of Natural History. I desire to express my thanks especially to Mr. A. Loveridge of Harvard, and Dr. Doris Cochran of the National Museum for their many courtesies while I was studying in these institutions, and to the directors and curators of other collections for their kindness in making available certain specimens.

Specimens from the various collections are referred to in this paper under the following initials:

A. M. N. H. . . . . American Museum of Natural History
A. N. S. P. . . . . Academy of Natural Sciences of Philadelphia
C. N. H. M. . . . . Chicago Natural History Museum
EHT-HMS . . . . . Edward H. Taylor-Hobart M. Smith collection
M. C. Z. . . . . Museum of Comparative Zoology of Harvard College
M. Z. U. M. . . . . Museum of Zoology, University of Michigan
M. N. H. . . . . Museum of Natural History, University of Kansas
R. C. T. . . . . Richard C. Taylor collection
U. S. N. M. . . . . United States National Museum.

HISTORY OF COLLECTIONS AND LITERATURE

The first considerable collection of Costa Rican snakes made by Dr. Carl Hoffmann, in Costa Rica prior to 1859 and forwarded to

the Royal Zoological Museum in Berlin, formed the basis of a report by Prof. W. Peters* in 1859. The paper contained a listing of the following 21 snakes. Eighteen of the snakes were of species previously described from neighboring countries. Three were described as new. (The original nomenclature is used):

Colobognathus Hoffmannii nov. gen. et sp.
Hydromorphus concolor nov. gen. et sp.
Bothriechis nigroviridis nov. gen. et sp.
Streptophorus Sebae Duméril, Bibron, and Duméril
Herpetrodryas Boddaertii Schlegel [Sentzen]
Herpetodryas Rappii Günther
Spilotes melanurus Schlegel
Spilotes variabilis Merrem
Leptophis ahaetulla Linné
Leptophis margaritifer Schlegel
Liophis cobella Linné
Homalocranium melanocephalum Duméril, Bibron and Duméril
Oxybelis Catisbyi Schlegel
Oxybelis aeneus Wagler
Erythrolamprus venustissimus Wied
Dipsas annulata Linné
Himantodes cenchoa Linné
Hydrophis bicolor Daudin
Elaps semipartitus Duméril, Bibron and Duméril
Elaps circinalis Duméril, Bibron and Duméril
Bothrops bilineatus Wied

The specimens do not have the exact localities reported with the exception of *Oxybelis aeneus* ("Candalariogebirge und Punta de Arenas"), *Hydrophis bicolor* from "Gulfo dulce," *Bothrops bilineatus* and *Bothriechis nigroviridis* (Volcán Barba).

In 1861 Peters† described *Typhlops (Helminthophis) frontalis* from a specimen collected by Dr. Carl Hoffmann and forwarded to Germany after his death, by Dr. von Frantzius.

Some 12 years after Peters' first report, a herpetological collection made chiefly in the region about San José, Costa Rica by Dr. Van Patten, reached Edward D. Cope ‡ at Philadelphia. Thirty-three species of snakes were represented in the collection. The following new species were described: *Colobognathus dolichocephalus, Colobognathus brachycephalus* and *Rhadinaea serperastra.*

Besides these three the following were included:

Candisona durissa Linnaeus
Bothrops atrox Linnaeus
Bothriechis nigroviridis Peters
Bothriechis affinis Bocourt
Elaps nigrocinctus Girard
Elaps ornatissimus Jan (var.)
Elaps multifasciatus Jan
Pelamis bicolor Daudin
Dryiophis brevirostris Cope
Dryiophis acuminatus Wied
Thrasops ? mexicanus Duméril, Bibron and Duméril
Leptognathus nebulatus Linnaeus
Dipsas gemmistratus Cope

* Monatsb. König. Akad. Wiss. Berlin, 1859, pp. 275-278.

† Monatsb. Akad. Wiss. Berlin, Oct. 1860 (1861), pp. 517-521.

‡ Ninth Contribution to the Herpetology of Tropical America, Proc. Acad. Nat. Sci. Philadelphia, 1871, pp. 200-224.

Leptodeira annulata var.
Leptodeira annulata var.
Masticophis margaritiferus Schlegel
Masticophis boddaertii Schlegel
Herpetodryas carinatus Linnaeus
Spilotes melanurus Duméril, Bibron and Duméril
Liophis epinephelus Cope
Coniophanes fissidens Günther
Conophis lineatus Duméril, Bibron and Duméril
Erythrolamprus venustissimus Linnaeus
Tantilla melanocephala Linnaeus
Tantilla melanocephala Linnaeus (var.)
Stenorhina ventralis Duméril, Bibron and Duméril
Stenorhina degenhardtii Berthold
Ninia maculata Peters
Ninia atrata Hallowell
Colobognathus hoffmannii Peters
Epicrates cenchria Linnaeus

Eight or nine, perhaps more, of the Van Patten species duplicate specimens collected by Hoffmann. One of the species listed in this paper as *Tantilla melanocephala* variety, is later described as *Tantilla armillata sp. nov.**

William Gabb of Philadelphia, under the auspices of the Government of Costa Rica, made a second important collection in southeastern and southern Costa Rica east of the Cordillera de Talamanca and on Pico Blanco (3565 m.), one of the highest peaks of the range. This collection was much more extensive than that made by Dr. Van Patten. It contained five turtles, 19 lizards, 35 serpents and 30 amphibians with a total of 37 forms presumably new to science. In the paper * in which Cope reported the collection, sixty species and/or subspecies of serpents are listed; of these 35 were represented in the Gabb collection. The remaining 25 forms were either in the Van Patten collection or from a small collection sent from Costa Rica by Mr. Riotte; or they were specimens listed or reported by other authors. Thirteen species are described as new. The list follows:

Helminthophis frontalis Peters
Xiphosoma annulatum sp. nov.
Boa imperator Daudin
Leptognathus annulata Günther
Leptognathus argus sp. nov.
Leptognathus pictiventris sp. nov.
Leptognathus nebulata Linnaeus
Dipsas cenchoa Linnaeus
Sibon annulatum Linnaeus
Oxyrrhopus plumbeus Wied
Oxyrrhopus petolarius Linnaeus
Dryiophis brevirostris Cope
Dryiophis acuminatus Wied
Leptophis aeruginosus sp. nov.
Leptophis saturatus sp. nov.
Leptophis praestans Cope
Dendrophidium melanotropis sp. nov.
Drymobius margaritiferus Schlegel
Drymobius boddaertii Sentzen
Herpetodryas carinatus Linnaeus
Herpetodryas grandisquamis Peters
Spilotes pullatus Linnaeus
Spilotes corais melanurus Duméril Bibron and Duméril
Spilotes chrysobronchus sp. nov.
Coniophanes fissidens Günther
Pliocercus dimidiatus Cope
Rhadinaea decorata Günther
Rhadinaea serperastra Cope
Erythrolamprus venustissimus Wied

* Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875), pp. 128-152.

Xenodon angustirostris Peters
Stenorhina ventralis Duméril, Bibron and Duméril
Tantilla armillata sp. nov. (from Van Patten Coll.)
Microdromus virgatus Günther
Ninia sebae tessellatus Cope
Contia pachyura sp. nov.
Contia calligaster sp. nov.
Catostoma psephotum sp. nov.
Colobognathus hoffmannii Peters
Elaps circinalis Duméril, Bibron and Duméril
Teleurapsis schlegelii Berthold
Bothriechis nigroviridis Peters
Bothriechis lateralis Peters
Bothriechis affinis Boucourt
Bothriopsis proboscideus sp. nov.
Bothrops atrox Linnaeus
Lachesis stenophrys sp. nov.

A collection sent to Edward D. Cope from Costa Rica by Sr. Don José Zeledón was reported upon by Cope in 1879.* Three snakes not previously listed from Costa Rica appear: *Scolecophis zonatus* Hallowell, *Coluber triaspis* Cope, and *Porthidium nasutum* Bocourt.

Cope, in 1893† received and reported on a collection of reptiles and amphibians from Mr. George K. Cherrie of San José, Costa Rica, among which were three new species. In the following list the first six species had not been previously listed for Costa Rica.

Rhadinaea ignita Cope
Drymobius rhombifer Peters
Drymobius caeruleus Fischer
Drymobius percarinatus sp. nov.
Synchalinus corrallioides gen. et sp. nov.
Sibon septentrionale rubricatum subsp. nov.
Colobognathus hoffmannii Peters
Oxybelis acuminata Wied
Elaps nigrocinctus Girard

In 1894 Cope ‡ reports on a series of specimens from the Museo Nacional de Costa Rica. The following are listed, four of which are new.

Trimetopon pliolepis sp. nov.
Drymobius paucicarinatus sp. nov.
Leptophis ultramarinus sp. nov.
Pogonaspis ruficeps sp. nov.
Enulius torquatus Günther

In Otto Wettstein's "Ergebnisse der österreichischen Costa Rica-Expedition 1930; Die Amphibien und Reptilien,"¶ the following snakes are listed as follows:

Leptotyphlops (= *Glauconia*) *albifrons* Wagler
Boa (= *Corallus*) *annulata* Cope
Sibynophis (= *Polyodontophis*) *venustissimus* Günther
Drymobius (*Eudryas*) *boddaertii* Sentzen
Drymobius (*Drymobius*) *margaritiferus* Schlegel
Spilotes pullatus pullatus Linnaeus
Drymarchon corais melanurus Duméril and Bibron
Chironius (= *Herpetodryas*) *fuscus grandisquamis* Peters
Leptophis mexicanus Duméril and Bibron

* Amer. Philos. Soc., vol. 18, no. 104, Aug. 11, 1879.
† Cope, Amer. Philos. Soc., 1893, p. 333.
‡ Proc. Acad. Nat. Sci. Philadelphia, 1894, pp. 194-206.
¶ Sitz, Akad. Wiss. Wien, Math.-Naturw. Kl. Abt. 1. Bd. 143, Heft 1-2, 1934, pp. 1-39.

Leptophis occidentalis occidentalis Günther
Leptophis bilineatus Günther
Liophis (= *Rhadinaea*) *cobella* Linnaeus
Liophis (= *Rhadinaea*) *pulveriventris* Boulenger
Ophis (= *Xenodon*) *colubrinus* Günther
Urotheca elapoides Cope
Catostoma (= *Geophis* = *Dirosema*) *brachycephala* Cope
Imantodes cenchoa Linnaeus
Leptodeira ocellata Günther (= *L. annulata personata* Cope)
Clelia (= *Oxyrhopus*) *cloelia* Daudin
Erythrolamprus aesculapii Linnaeus
Coniophanes (= *Erythrolamprus*) *imperialis imperialis* Baird and Girard
Tantilla (= *Homalocranium*) *virgata* Günther
Stenorhina degenhardtii Berthold
Micrurus (= *Elaps*) *mipartitus multifasciatus* Jan
Micrurus (= *Elaps*) *nigrocinctus nigrocinctus* Girard
Bothrops nasuta Bocourt (Amaral)
Bothrops nigroviridis nigroviridus Peters
Bothrops ophryomegas Bocourt (Amaral)
Bothrops schlegelii Berthold
Crotalus terrificus durissus Cope

In 1887 Cope in his "Catalogue of the Batrachians and Reptiles of Central America and Mexico" listed the herpetological fauna of Central America known at that time. The names of some 67 species and subspecies of snakes are given as occurring in Costa Rica. Certain of these names are now regarded as synonyms of others in the list, as for example, *Phylothamnus aeruginosus* Cope, *Leptophis bilineatus* Günther and *Hapsidophrys saturatus* (Cope) are placed now in the synonymy of *Thalerophis depressirostris* (Cope) by Dr. James A. Oliver, the latest reviewer of this group of colubrine snakes.

Between April 1893, and October 1895, the section of the "Biologia Centrali-Americana" dealing with Serpentes was published by Günther. Approximately 76 forms are reported for Costa Rica. This is one of the most significant works dealing with Central American Faunas, and it contains numerous excellent illustrations. The collections in the British Museum form the basis for this work.

Another work of even more importance for the study of Central American snakes is the great "Études sur les Reptiles;" Mission Scientifique au Mexique et dans l'Amérique Centrale. The livraisons nos. 8-17 dealing with the serpent fauna appeared between 1882 and 1909. The first 8 livraisons (nos. 8-15) were under the authorship of Fermin Bocourt, the last two (nos. 16-17) were written by Dr. F. Mocquard. This work contains hundreds of excellent

figures. Many Costa Rican specimens are listed. The collections treated in this work were primarily those of the Paris Museum, especially those obtained by the Mission Scientifique. However, specimens from other museums are included.

From 1893-1896 the Catalogues of the Snakes in the British Museum vols. I-III appeared and here again Costa Rican forms in the British Museum are listed.

From 1896 to 1920, nearly a quarter of a century, little was published that dealt directly with Costa Rican herpetological faunas. In the latter year E. R. Dunn, then collecting for Harvard University was sent to Costa Rica. This marked a beginning of renewed interest in this area. Later, other journeys were made by him to Central America, and one or more other visits were made to Costa Rica. No detailed reports of these collections have been made, but a few forms from Costa Rica have been described from these or other collections, among which may be mentioned are:

Thalerophis nebulosus Oliver
Lampropeltis triangulum gaigae Dunn
Leimadophis epinephelus juvenilis Dunn
Trimetopon viquezi Dunn
Trimetopon simile Dunn
Rhadinaea persimilis Dunn
Dipsas ruthveni Barbour and Dunn
Rhinobothryum bovallii Andersson
Conophis nevermanni Dunn
Trimeresurus picadoi Dunn

Three works by Costa Rican authors dealing in part with the herpetological faunas are: "Serpientes venenosas de Costa Rica sus veninos seroterapia anti-ofidica" (1931) by C. Picado T. This treats of the various species of the poisonous genera *Lachesis, Bothrops, Crotalus, Micrurus* and *Pelamis.* Numerous good illustrations of these species are given. A few harmless species are figured that seem to mimic the poisonous forms.

The other works are "Animales Venenosos de Costa Rica" (1935) by Lic. Carlos Viquez S. and "Nuestros Animales Venenosos" (1941) by the same author. The second book is in the nature of a second edition of the first; but it is rewritten and revised with many new figures added and it may be regarded essentially as a new work. One of the features is a listing of the known snake species from Costa Rica, compiled from literature. The list contains 113 names. This number must be reduced by approximately a dozen names that are synonyms or repetitions. Maps showing distribution of a few forms are given.

GEOGRAPHICAL AND CLIMATIC CONSIDERATIONS

The country of Costa Rica, lying as it does athwart the tenuous land mass that is Central America, has a fauna reflecting in great measure the spread of forms from the continental part of North America (Mexico) and from South America. It has served as a portion of the roadway along which have settled many of the migrant forms, more coming perhaps from the north than from the south. Geological evidence points to the fact that at times the roadway has not been a continuous route; there have been breaks in the land mass, leaving one or possibly even a chain of islands in its stead.

Animals arriving in Central America, encountering new environmental stimuli, often changed until no longer may the taxonomist recognize in them the characters of their immediate ancestors living or dead, but he must consider them as new local creations whose ancestry may only be conjectured. Thus many of the individual species now recognized in the fauna have developed *in situ,* descendants of older residents or migrants.

Moreover the spread of forms from the north or the south has taken place at various times and the degree of variation in local populations may offer a chronometer for measuring the relative time of arrival.

That the migration or spreading of species still continues is suggested by the fact that only a single representative of the large northern genus *Thamnophis* has reached Costa Rica and to our knowledge, has as yet not reached Panamá. Moreover, many species have entered Panamá from the south that have not been encountered across the border in Costa Rica. In this series such genera as *Lygophis, Trypanurgos, Peropodum, Trachyboa* and *Atractus* may be cited. Certain of these, of course, may actually occur and will eventually be reported for Costa Rica.

The fauna contains a few elements that did not arrive by land. These are species that have braved ocean voyages, or not impossibly, were brought unintentionally by man. Two forms appear to have arrived via a water route. These are *Tretanorhinus nigroluteus nigroluteus* and *Pelamis platyurus.* Of these, the first may be a relatively recent coastal arrival and while as yet no specimen has been found along the coastal or inland waters of Costa Rica, since it occurs both north and south of the country, its presence there is to be regarded as unquestionable. The second is a marine species from South Asia and the Malay Archipelago and the fact that it shows so few fixed differences from Asiatic members of the species,

may suggest an arrival in historic times, from, say, the Philippines as a stow-away on Spanish galleons. We are aware that something of this sort has happened in the case of a land snake *Typhlops braminus*, and certain lizards *Peropus mutilatus* and *Hemidactylus frenatus* in Mexico. The question whether the species could spread from a point of landing, south along the Central and South American coasts and/or north along the Central American and Mexican coasts during post-Columbian times, I believe, can be answered in the affirmative. I see nothing inconsistent in such a happening. Moreover, while certain species of sea serpents have definite migrations, I cannot believe that a bottom-feeding snake could survive a slow journey under its own power across the Pacific Ocean.

The country of Costa Rica is not large; it has a north-south length of approximately two hundred and fifty miles, and a total estimated area of 19,238 square miles.

Prior to the present geological uplift, which has connected North America and South America by the Panamá land bridge, and presumably Costa Rica to Nicaragua by a similar connection, it is highly probable that Costa Rica and the adjoining high part of Panamá constituted an island separated by relatively narrow straits from the high land of Nicaragua and likewise from the high land of eastern Panamá. At the point where Costa Rica bounds Nicaragua, the land is less than 100 meters above sea level. However, beginning near the northwestern border, and extending diagonally in a southeasterly direction, is a mountain chain that for a hundred miles maintains an elevation above 1000 meters, save for a single short break. It is known variously as the Cordillera Volcanica, and the northern part at least is called Cordillera de Guanacaste. In this range is a series of mountain peaks, mostly volcanoes. The northernmost is Volcán Orosi (1499 m.). Then follow Volcán Rincón de la Vieja (1502 m.), Volcán Miravalles (1750 m.), Volcán Tenorio (1432 m.), and Volcán Canaste (Pelón) (1900 m.).

Near the southern end of this Cordillera, there is a break in the continuity with the southern mountains (Cordillera Talamanca), but it is contiguous on the east with a shorter, higher range having only a slightly diagonal trend, the main axis being nearly east-west in direction. This is called the Cordillera Central and maintains throughout its length an elevation above 1500 m. with a series of volcanic peaks from west to east as follows: Volcán Poás (2760 m.); Volcán Barba (2929 m.); Irazú (3452 m.); Turrialba (3421 m.), the two latter being connected by a high isthmus above 2150 m. in elevation.

Immediately to the south of these ranges is the central plateau region. Here are to be found two rivers, the Rió Grande, draining to the Pacific via the Gulf of Nicoya and Rió Reventazón, flowing eastward into the Caribbean Sea. The minimum elevation of the divide between these two rivers is 1566 m. and represents the elevation of the isthmus connecting the Irazú volcano with the great southern Cordillera de Talamanca. Here too, on either side of the central plateau are the chief cities, San José, Cartago, Alajuela, Heredia, and Turrialba.

The directional trend of the Cordillera de Talamanca is to the southeast, practically the same as that of the mountain chain in northern Costa Rica. It maintains an elevation of 2150 m. for 110 miles save for a single break where a pass having an elevation somewhat more than 1538 m. occurs. There is a series of peaks in this chain as follows (north to south): Cerro las Vueltas, 3087 m.; Cerro Guericí, 3540 m.; Cerro de la Muerte, 3670 m.; Cerro Chirripo Grande, 3837 m., Cerro Durika, 3296 m.; Cerro Cruz del Obispo, 3099 m.; Pico Blanco, 3565 m. and Cerro Pando, 3162 m.

Northward a few peaks are isolated from the main range. Cerros de Escaso and Cerros de Bustamente are highest, with elevations 2425 m. and 2419 m. respectively. This mountain mass appears on certain maps as the Aguacate Mountains.

The peninsula of Nicoya jutting from the northwestern mainland has highlands connecting with the mainland by land, none of which reaches an elevation of 100 meters elevation and most of which is much lower; while in the mountainous portion elevations up to 1017 meters are recorded. At the southern extremity of the country on the Pacific side, the Peninsula de Osa as well as the mountain mass known as Pico de Burica present similar relations to the mainland. Elevations of 688 m. and 708 m. respectively are known. All three of these areas must have experienced island or archipelagic conditions in the past.

A study of Mexican faunae have shown marked differences in the components of the faunae of various high mountains. Mount Chiriquí, lying in northwestern Panamá, isolated from the main cordillera, seemingly has a fauna showing considerable differentiation from that of neighboring mountains. Such differences probably likewise obtain in certain of the isolated peaks of the Costa Rican mountains.

A series of outline maps have been made following the elevation contours at sea level, at 1000 feet, 3000 feet, 5000 feet, 7000 feet

and 9000 feet. These, better than any description, show the degree and extent of isolation of the mountain masses at the elevations given.

Outline maps of Costa Rica showing outline of the entire country; and the 1000, 3000, 5000, 7000, and 9000 foot contours (indicated by heavier lines).

The northern and southern areas are connected at elevation of 1566 m. (5000 ft.) but above this there is a break and animals adapted to elevations of 2000 m. and above are more or less effectively isolated. At still higher elevations there are several mountain "islands" separated from each other by varying distances. Whether it will eventually be shown that each of these higher peaks has endemic faunal elements is now only a matter of conjecture. Certain of them certainly have. The age of the various mountains (or volcanoes) will be a factor. One may presume the oldest ones, other things being equal, will display modifications in the greatest number of species. Unfortunately, fewer snakes become adapted to the higher elevations than either amphibians or lizards.

The extent to which one may divide the country into faunal zones and faunal areas purely on the study of the serpent fauna alone cannot be determined with any degree of certainty at the moment, since the distributional data are too meager and the collecting too haphazard. Many specimens in collections lack data as to locality, and if this is known, exact elevation data is often lacking.

The eastern, Caribbean, drainage area, and the Pacific drainage area together with the dry portions of the central plateau, constitute two areas differing considerably in amount of rainfall, and the concommitant differences in vegetation. The lowlands of the eastern area have an annual rainfall in excess of 200 inches a year. This is spread throughout the year with heavier fall in midwinter, December and January, and midsummer, June and July. As one approaches the summits of the cordilleras, the rainfall becomes less but even here the vegetation is lush. On the summits of the higher peaks the forest is absent but at least in the southern Cordillera the summits have much short bamboo that forms often practically impenetrable thickets. The ground itself is covered with moss and lichens, offering shelter for a very considerable salamander population.

The western Pacific slope is deprived of much of the moisture because of the excessive precipitation on the eastern slope caused by the high central mountains. Here the rainfall is confined very largely to the summer months, May to August, while the remainder of the year is dry, and months may pass with practically no rainfall. The dry season has much wind which results in further moisture loss.

Costa Rica is divided into a series of provinces in such a manner that a listing of the provincial faunas would contribute little to an understanding of distributional problems. Hence little effort has been made to associate place names with provinces.

FAUNA

The serpent fauna, for the size of the country and the present state of our knowledge, is large. This is due, in a measure, to the rugged and divergent characteristics of the topography, which allow for the interplay of a great variety of environmental stimuli on this plastic and definitely expanding group of reptiles. At the same time it has available necessary isolating barriers to select and fix the mutations that result. In this paper 132 species and subspecies are considered. These are arranged in 56 genera, under seven families.

The subfamilies of the Colubridae here treated are four; however the group Colubrinae is further divisible into other subfamily groups of perhaps equal rank with certain of those here treated. Certain of the species of snakes that have been listed heretofore for Costa Rica appear to be synonyms, and are so treated here; others so listed may be legitimate members of the fauna, but since I am unable to find verification of the record are not included. In this latter class are certain forms listed by Lic. Carlos Viquez S * as follows: *Anomalepis mexicana; Epicrates cenchria cenchria; Leimadophis taeniurus epinephalus; Atractus quadrivirgatus [= Adelphicos quadrivirgatus]; Urotheca lateristrigata [= Rhadinaea lateristrigata]; Urotheca elapoides elapoides [= Pliocercus elapoides elapoides]; Pseudoboa newiedii [= Clelia newiedii]; Micrurus elegans.*

The report of *Pseudoboa newiedii* Duméril, Bibron and Duméril *[= Clelia newiedii]* appears also in Amaral, Mem. Instit. Butantan, tome 4, p. 207 (81) and may be based on a legitimate report. However, I have not found record of any specimen taken in the country.

Synchalinus corralliodes Cope is regarded by Dunn as being a synonym of *Phrynonax poecilonotus.* I have not examined the type.

Ungaliophis continentalis F. Müller is reported by Amaral (Mem. Inst. Butantan, 1929, IV, p. 145 (19) "Guatemala occidental até Panamá). I have been unable to ascertain that the species has been taken south of Nicaragua.†

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* Nuestros Animales Venenosos, 1941, pp. 65-57.

† In the latest revision of the Boidae, Stull (Proc. Boston Soc. Nat. Hist., vol. 40, no. 8, pp. 387-408) revives the generic name *Peropodum* F. Müller for *Ungaliophis* dating the name from Müller, 1878, Verh. Nat. Ges. Basel, vol. 6, p. 652, pl. 1. It is true that on this page Müller did describe the genus *Peropodum*, and then proceeded to describe a snake without giving it a name, but the name appears elsewhere. In the listing of species on page 573, it appears "Boaedarum n. gen. et. sp. ?." The name Boaedarum is not intended as a generic name but is the genitive plural form of the family name. However, on page 591, one finds the following:

"Nov. gen. Boid. Affin. Ungal (Anm. 13)

"Spec. guatemalensis.

"a. Retalulèu, costa grande v Guatemala, gesch. v. Dr. G. Bernoulli."

The (Anm. 13) refers to No. 13 of the Anmerkungen zum Katalog, which reads as follows:

ACKNOWLEDGEMENTS

I wish to offer my gratitude to the Kansas University Endowment Association, who generously provided a considerable portion of the funds for defraying my personal expenses in travel to and from Costa Rica, and travel and other expenses within the country.

I am deeply obligated to the President of the National University, Dr. Fernando Baudrit, for his generous invitation to become a guest of that Institution and spend the summer in Costa Rica in the study of the herpetological faunas.

My heartfelt thanks are offered to the genial, gifted, Prof. Rubén Torres Rojas, my official host in the country who joined me on certain memorable field expeditions; presented me with specimens, and "smoothed the way" for me on numerous occasions while I was entering and leaving the country.

I am under deep obligation to Dr. Ralph H. Allee, Director of the Inter-American Institute of Agricultural Sciences at Turrialba, who allowed me the privilege of making the Institute my headquarters, in furnishing transportation and for other very numerous courtesies. I am also under obligation to members of his staff: Dr. Frederick Wellman and Mrs. Wellman, Dr. Guillermo Bonilla, Dr. Cáceras, Dr. Rhoades, Mr. James Forman, and others who were untiring in their courtesy. A number of specimens collected by the Director's son, Mr. David Allee, were presented to the collection.

A number of other persons likewise merit my sincere thanks. A visit to the American Cinchona Plantation on Volcán Poás was arranged by Captain Hope, Production Manager of the plantation, who also provided transportation. Mr. Deal Thornton, the Station Director offered the facilities of the plantation and provided transportation.

Mr. Harshberger and Mr. Virgil Cave, officials of the Pan-American Highway, offered the facilities of the camps at Millville, near the summit of Cerro de la Muerte, and that at San Isidro El General. Mr. Cave presented the collection with several important specimens and provided much transportation.

To Mr. Wallace E. Manis, my genial and discerning host at Los Diamantes (U. S. Department of Agriculture Rubber Station), I offer my very cordial thanks.

"(13) Boïdae von Guatemala Peropodum, n. sp. et genus ? (Hiezu Tafel I). Costa Grande." Then follows a generic description and a species description of *guatemalensis*. Thus there can be no question that both genus and species are correctly established. The name has been attributed by Boulenger to Bocourt, Miss. Sc. Mex., Rept., p. 522, 1882. Accepting the synonymy of *Ungaliophis continentalis* F. Müller and *Peropodum guatemalensis* F. Müller, the latter name, not the former, must be used.

I am under obligation to several other persons, for specimens and courtesies, among whom may be mentioned are Prof. Marco Tullio Pacheco who collected with me and presented to me certain valuable specimens. Mr. Good and his sister, Miss Good, hosts at Finca Dominica at Turrialba, graciously permitted me to obtain a fine series of *Basiliscus plumifrons* from the shrubbery about the home. Señor Antonio Machado of the American Cinchona Plantation presented the collection with several fine specimens.

To Mr. Richard Taylor, I am grateful for his companionship and constant aid in the field, for the transportation by air of some forty pounds of my equipment, and finally for permission to study the collection which he made.

CHECKLIST OF THE SERPENTS OF COSTA RICA

The following list of genera, species, and subspecies are tentatively recognized in this paper. The genera number 56, the species and subspecies 132. (Figures in parentheses refer to page numbers in this volume.)

Family Anomalepidae (24)
- Genus Anomalepis Jan (24)
  - *dentatus* Taylor (24)
- Genus Liotyphlops Peters (25)
  - *albirostris* (Peters) (25)
- Genus Helminthophis Peters (26)
  - *frontalis* (Peters) (26)

Family Leptotyphlopidae (27)
- Genus Leptotyphlops Fitzinger (27)
  - *albifrons* (Wagler) (27)

Family Boidae (28)
- Genus Boa Linnaeus (28)
  - *annulata* (Cope) (28)
- Genus Constrictor Laurenti (29)
  - *constrictor imperator* (Daudin) (29)
- Genus Epicrates Wagler (30)
  - *cenchria maurus* Gray (30)

Family Colubridae (30)
- Subfamily Acrochordinae (30)
  - Genus Nothopsis Cope (30)
    - *torresi sp. nov.* (31)
- Subfamily Sibynophinae (35)
  - Genus Scaphiodontophis Taylor and Smith (35)
    - *venustissimus* (Günther) (35)
- Subfamily Natricinae (36)
  - Genus Thamnophis Fitzinger (36)
    - *sirtalis chalceus* (Cope) (36)
- Subfamily Colubrinae (composite) (37)

Genus Geophis Wagler (38)
[*rhodogaster* (Cope)] (39)
godmani Boulenger (40)
hoffmanni (Peters) (40)
dolichocephala (Cope) (43)
moesta Günther (44)
brachycephala (Cope) (46)
Genus Ninia Baird and Girard (49)
sebae sebae Duméril, Bibron and Duméril (50)
atrata (Hallowell) (50)
maculata (Peters) (51)
tessellata Cope (53)
psephota (Cope) (55)
oxynota (Werner) (55)
Genus Dipsas Laurenti (58)
anthracops (Cope) (59)
pictiventris (Cope) (59)
argus (Cope) (60)
articulata (Cope) (61)
annulata (Günther) (61)
ruthveni (Barbour and Dunn) (62)
costaricensis sp. nov. (62)
Genus Sibon Fitzinger (67)
nebulatus (Linnaeus) (67)
Genus Neoparias Günther (66)
bicolor Günther (66)
Genus Tretanorhinus Duméril, Bibron and Duméril (66)
nigroluteus nigroluteus Cope (67)
Genus Xenodon Boie (68)
bertholdi Jan (69)
colubrinus Günther (69)
Genus Enulius Cope (70)
flavitorques (Cope) (70)
sclateri (Boulenger) (71)
Genus Helicops Wagler (74)
wettsteini Amaral (74)
Genus Hydromorphus Peters (74)
concolor Peters (74)
Genus Trimetopon Cope (75)
pliolepis Cope (76)
viquezi Dunn (78)
simile Dunn (79)
gracile (Günther) (79)
Genus Hypsiglena Cope (80)
torquata torquata (Günther) (80)
Genus Amastridium (80)
veliferum Cope (81)
Genus Spilotes Wagler (82)
pullatus pullatus (Linnaeus) (82)
pullatus mexicanus (Laurenti) (83)

Genus Thalerophis Oliver (84)
mexicanus mexicanus Duméril, Bibron and Duméril (84)
depressirostris (Cope) (85)
nebulosus (Oliver) (85)
richardi occidentalis (Günther) (86)
Genus Dryadophis Stuart (87)
melanolomus alternatus (Bocourt) (87)
Genus Drymobius Fitzinger (88)
margaritiferus margaritiferus (Schlegel) (89)
rhombifer (Günther) (89)
chloroticus (Cope) (90)
melanotropis (Cope) (91)
Genus Dendrophidion Fitzinger (91)
paucicarinatus (Cope) (91)
dendrophis (Schlegel) (92)
Genus Pseustes Fitzinger (92)
poecilonotus chrysobronchus (Cope) (92)
shropshirei Barbour and Amaral
Genus Chironius Fitzinger (95)
carinatus (Linnaeus) (95)
grandisquamis (Peters) (96)
melas (Cope) (97)
Genus Elaphe Fitzinger (97)
triaspis (Cope) (98)
flavirufa flavirufa (Cope) (98)
Genus Drymachron Fitzinger (99)
corais melanurus Duméril, Bibron and Duméril (99)
Genus Masticophis Baird and Girard (100)
mentovarius Duméril, Bibron and Duméril (100)
Genus Leptodrymus Amaral (101)
pulcherrimus (Cope) (101)
Genus Leimadophis Fitzinger (102)
taeniurus juvenilis Dunn (102)
Genus Lampropeltis (103)
doliata micropholis Cope (104)
doliata polyzona Cope (103)
doliata gaigae Dune (104)
Genus Pliocercus Cope (106)
dimidiatus Cope (106)
annellatus sp. nov. (107)
Genus Liophis Wagler (110)
cobella Linnaeus (110)
Genus Rhadinaea Cope (111)
serperastra Cope (112)
calligaster (Cope) (113)
decorata decorata Günther (113)
pulveriventris Boulenger (116)
vermiculaticeps (Cope) (116)
persimilis Dunn (117)
pachyura pachyura (Cope) (117)
pachyura decipiens (Günther) (118)

Grooved back-fang series [Boiginae] (118)
Genus Trimorphodon Cope (120)
biscutatus biscutatus Duméril, Bibron and Duméril (120)
Genus Leptodeira Fitzinger (121)
nigrofasciata Günther (121)
rubricata (Cope) 122)
annulata annulata (Linnaeus) (122)
ocellata Günther (125)
rhombifera Günther (126)
maculata (Hallowell) (126)
Genus Oxybelis Wagler (127)
fulgidus (Daudin) (127)
brevirostris (Cope) (128)
aeneus (Wagler) (128)
Genus Imantodes Duméril and Bibron (130)
inornatus Boulenger (130)
cenchoa semifasciatus Cope (132)
gemmistratus Cope (135)
Genus Clelia Fitzinger (135)
clelia clelia Daudin (135)
petolarius (Linnaeus) (138)
Genus Erythrolamprus Boie (140)
bizonus Jan (140)
Genus Coniophanes Hallowell (141)
decipiens (Günther) (141)
piceivittis Cope (142)
fissidens punctigularis Cope (142)
Genus Rhinobothryum Wagler (144)
bovalii Andersson (144)
Genus Conophis Peters (145)
lineatus dunni Smith (145)
nevermanni Dunn (145)
Genus Stenorrhina Duméril (146)
degenhardtii degenhardtii (Berthold) (146)
degenhardtii apiata Cope (147)
freminvillii freminvillii Duméril, Bibron and Duméril (147)
Genus Scolecophis Fitzinger (148)
atrocinctus (Schlegel) (148)
Genus Tantilla Baird and Girard (149)
annulata Boettger (149)
armillata Cope (152)
reticulata Cope (153)
virgata (Günther) (154)
shistosa (Bocourt) (155)
ruficeps (Cope) (156)
Family Hydrophiidae (156)
Genus Pelamis Daudin (156)
platurus (Linnaeus) (156)

Family Elapidae (157)
Genus Micrurus Wagler (157)
mipartitus multifasciata (Jan) (158)
nigrocinctus nigrocinctus (Girard) (160)
nigrocinctus mosquitensis Schmidt (164)
pachecoi sp. nov. (165)
clarki Schmidt (168)
alleni richardi subsp. nov. (169)
Family Viperidae (172)
Genus Bothrops Wagler (composite) (172)
atrox atrox (Linaeus) (179)
nummifer (Rüppell) (181)
picadoi Dunn (180)
nasuta Bocourt (177)
ophryomegas Bocourt (178)
lansbergii (Schlegel) (178)
nigroviridis nigroviridis (Peters) (176)
lateralis (Peters) (175)
godmani (Günther) (183)
schlegelii (Berthold) (173)
Genus Crotalus Linnaeus (183)
terrificus durissus Linnaeus (183)
Genus Lachesis Daudin (184)
muta stenophrys Cope (184)

KEY TO FAMILIES OF COSTA RICAN SNAKES

1. Scales on midventral line of belly not, or scarcely, wider than adjoining scales.... 2
   Scales on belly several times wider than adjoining scales..... 5
2. Tail short strongly compressed vertically, forming an oar; marine snakes; eye well developed .....Hydrophiidae
   Tail very short, round; eye covered with head shields, concealed or faintly visible. 3
3. Teeth in lower jaw only; ocular scale reaching lip; scales in 14 rows around the body .....Leptotyphlopidae
   Teeth in upper jaw or in both jaws..... 4
4. Teeth in upper jaw only; ocular separated from lip by labial scale; hyobranchium Y-shaped .....Typhlopidae*
   Teeth in one or both jaws; ocular separated from lips by two scales; hyobranchium W-shaped .....Anomalepidae
5. A deep pit between nostril and eye.....Viperidae
   No pit between nostril and eye..... 6
6. Anterior part of maxillary provided with a stationary grooved fang.....Elapidae
   Anterior part of maxillary without a grooved fang; however the posterior tooth in maxilla may be grooved..... 7
7. Vestiges of hind limbs; ventral scales relatively narrow, distinctly less than width of body .....Boidae
   No vestiges of hind limbs; ventral scales as wide as or wider than body, normally .....Colubridae

* Typhlopidae is included in the key, although no specimen of the family has been reported in Costa Rica. It occurs to the north, in Guatemala and south in Colombia.

FAMILY ANOMALEPIDAE

The recent findings of Tihen published under the name Dunn and Tihen,* and of Tihen† strongly suggest the wisdom of recognizing these small snakes under the family name proposed by Taylor.‡

Three genera, *Anomalepis*, *Helminthophis* and *Liotyphlops*, are regarded as belonging in this family.§ The three genera may be differentiated by the following key.

KEY TO COSTA RICAN ANOMALEPIDAE

1. Rostral less than half width of head; preoculars two 2
   Rostral at least half width of head; no preocular scales ..... *Liotyphlops*
   One subocular ..... *Helminthophis*
   Two suboculars ..... *Anomalepis*

Genus ANOMALEPIS Jan

Anomalepis Jan¶ in Jan and Sordelli, L'iconographie Générale des Ophidiens, livr. 1 (?Dec. 1860), p. 1, pl. 5, fig. 1; Arch. per la Zool., vol. 1, p. 185, 1861.

Genotype: *Anomalepis mexicanus* Jan.

Anomalepis dentatus Taylor

Anomalepis dentatus Taylor, Proc. New England Zool. Club, vol. 17, 1939, pp. 90-91 (type locality, Barro Colorado Island, Canal Zone**).

A small species of this genus reported from Costa Rica is referred to *dentatus*. The species may be recognized by the following characters: Very small snakes, known maximum size, 158 mm.; teeth in both jaws; rostral visible from above for a distance equal to its distance from frontal, its greatest width a little less than half

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* Dunn and Tihen, Journ. Morph., vol. 74, no. 2, 1944, pp. 287-294, pl. 1.

† Tihen, Copeia, 1945, no. 4, Dec. 31, pp. 204-210.

‡ Taylor, Proc. New England Zool. Club, vol. 17, 1939, pp. 87-96, pl. 5.

§ See Smith and Warner, Herpetologica, vol. 4, pt. 6, Dec. 8, 1948, pp. 189, 193.

¶ Not "Jan and Sordelli" as Dunn insists, Bull. Mus. Comp. Zool. Harvard Coll., vol. 87, No. 7, 1941, p. 511. According to Jan (Elenco sistematico degli Ofidi descritti e disegnati per L'iconografie générale, 1863, p. 9) the name *Anomalepis* dates from the cited publication; while the specific name is attributed to the Iconographie Générale des Ophidiens, livr. 1, dated December 1860 but presumably issued at a somewhat later date than that stated.

** In the original description, credit for the discovery of this form was attributed to James Zetek, since the label in the container and the invoice sent with the specimen contained Mr. Zetek's name. Dr. Emmet Reid Dunn has made a claim that he is the collector of the specimen that served as the type. Thinking Dr. Dunn's claim preposterous, I wrote to Mr. Loveridge of Harvard University from whom the specimen was borrowed. Mr. Loveridge admits an error in cataloguing the specimen. Dr. Dunn is the collector.

In a paper by Dunn (Bull. Mus. Comp. Zool. Harvard College, 87, 1941) attempting to correct some typographical errors in my original paper, and to excuse certain of his own previously published errors, he is guilty of further errors and questionable taste.

1. Dunn states that the authority for the name *Anomalepis mexicanus* is Jan and Sordelli. I have attributed the name to Jan, and this is correct despite Dunn's statement. Jan was solely responsible for the taxonomy. Sordelli was the illustrator. Jan makes this clear by associating his name alone with the species.

2. Dunn likewise makes this mistake on pages 511, 512, and likewise erroneously attributes the name *Leptognathus vagus* to the two authors.

3. On page 516 Dunn refers to a species of *Anomalepis* as *maxicanus*. No such species has been described.

Other errors in Dunn's paper will be taken up when occasion demands.

the width of head; prefrontals large, longer than wide, about as long as frontal; frontal broader than long, four times as large as the supraocular scales. Five scales border frontal, two laterally, the anterior of which is the supraocular; behind frontal is the postfrontal; following the postfrontal are two rather large median scales followed by two somewhat smaller median scales. The one touching the postfrontal is largest and bordered laterally by a quadrangular scale separated from the ocular by a somewhat smaller postocular.

Nasal divided, the lower anterior portion small; the nostril lying diagonally between the two parts; anterior supralabial large, widely separating nasals from mouth, its labial border narrower than labial borders of other supralabials; second supralabial small but larger than fourth and smaller than third which nearly equals first; loreal bounded by three labials in front and below, by the larger nasal and two preoculars above; two subequal suboculars and two postoculars, the upper much the larger; eye dimly visible; three infralabials; mental grooved but apparently not divided; when mouth is closed, six scales appear to border upper labials. A pair of preanal scales in contact anteriorly. Scale formula 28-24-22-22-24 (23 or 22). Dorsal scales from rostral to terminal caudal plate, 272. Scales under tail, 7-9. Total length (maximum known), 158 mm.; tail, 3 mm.

Genus LIOTYPHLOPS Peters

Liotyphlops Peters, Sitzb. Ges. naturf. Fr., 1881, p. 69.

Genotype: *Liotyphlops albirostris* Peters.

Whether more than a single species of *Liotyphlops* occurs in Costa Rica is difficult to say. If there is but one, there may be some doubt as to the proper name to apply to it. *Typhlops (Idiotyphlops) emunctus* Garman, *Rhinotyphlops albirostris* Peters and *Helminthophis canellei* Mocquard have been described from Panamá. *Helminthophis bondensis* Griffin, described from Bonda, Colombia, has been reported in Panamá also. The postulation that these species are based on anomalous specimens and are synonyms of *albirostris* needs confirmation.

Knowledge of the presence of the genus in Costa Rica is based on the report of a Costa Rican specimen of *Liotyphlops albirostris* in "Frankfort 7005a" (presumably Germany). There is a specimen of *Helminthophis eumunctus* in the U. S. National Museum said to be from Costa Rica, collected by J. A. McNeil. McNeil collected the type (M. C. Z. No. 3971) in Panamá. Perhaps the "Costa Rica" locality is an error.

Liotyphlops albirostris (Peters)

Rhinotyphlops albirostris Peters, Monatsb. Akad. Wiss. Berlin, 1857, p. 402 (type locality, Veragua).

Liotyphlops albirostris Peters, Sitz. Gesell. Naturf. Freunde, 1881, p. 69; Bocourt, Etudes sur les Reptiles; Mission Scientifique au Mexique et dans l'Amérique Centrale, livr. 8, 1882, pp. 501-502, pl. 30, fig. 1, 1a-1c (figure of type); Dunn, Proc. Biol. Soc. Washington, vol. 45, Oct. 1932, pp. 174-175 (Costa Rica).

Head narrowed and flattened somewhat; rostral well developed, narrowed at level of nostrils, half (or slightly more than half) width of head extending back beyond level of eyes, in contact with the frontal, which is at least twice as broad as long; two large prefrontals extending to posterior level of rostral but not in contact behind rostral; no preocular; two suboculars; eye distinguishable under the suture between the prefrontal and the small ocular; four upper labials, first largest touching rostral, second in contact narrowly with the prefrontal; the second and third supralabials separated from ocular by a subocular; scales in a row from mouth to anus approximately 392-414; 11-13 under tail; 22 scale rows around body.

Blackish or dark brown, each scale with a reddish brown border.

I regard *Liotyphlops eumunctus* (Garman) as a species distinct from *L. albirostris*. The scales of the type are approximately 425 mouth to anus, and 12 subcaudals. There are no enlarged anals. The scales following the frontal are three, the median transversely elongate.

Genus HELMINTHOPHIS Peters

Helminthophis Peters, Monatsb. Akad. Wiss. Berlin, 1860, p. 517; Tihen, Copeia, 1945, no. 4, Dec. 31, pp. 204-210; Smith and Warner, Herpetologica, vol. 4, pt. 6, Dec. 8, 1948, pp. 189-193.

Genotype: *Helminthophis frontalis*.

Helminthophis frontalis (Peters)

Typhlops (*Helminthophis*) *frontalis* Peters, Monatsb. Akad. Wiss. Berlin, 1860, p. 517, pl., fig. 1, a-c (type locality, Costa Rica).

Helminthophis frontalis Bocourt, Études sur les reptiles; Mission Scientifique au Mexique et dans l'Amérique Centrale, livr. 8, 1882, pp. 502-503, pl. 30, figs. 2, 2a-b; Boulenger, Catalogue of the Snakes of the British Mus., 2nd ed., vol. 1, pp. 5-6, 1893; Amaral, Proc. New England Zool. Club, vol. 9, 1924, p. 25; Mem. Inst. Butantan, Tomo 4, 1929, p. 136; Dunn, Proc. Biol. Soc. Washington, vol. 45, 1932, pp. 173-175 (San José, Costa Rica).

This diminutive, cylindrical, wormlike snake, without widened ventral scales, may be recognized by the following characteristics: dark brown above, a little lighter below; the head, neck and anal region white; rostral large and broad, somewhat less than half width of head, not extending back to the level of eyes, separated from frontal by the prefrontals, which form a common suture; fron-

tal broad; two preoculars and one subocular; eye distinguishable under the small ocular; four upper labials; ocular in contact with third supralabial or narrowly separated by the subocular; ocular scale separated from frontal by supraocular; upper preocular touches the second supralabial, lower preocular touches the second and third supralabials. Diameter of body about 58 times in total length; longitudinal scale rows 22; 23 transverse scale rows on tail. Total length, 158 mm.

I have examined a single Costa Rican specimen, M. C. Z. 34879. This specimen has the head and anterior part of the neck whitish cream without trace of pigment. The scale formula is 20-22-22. The scales from mouth to anus are approximately 476. Two large preoculars, the lower largely covering eye; ocular does not touch labial; upper preocular also separated from labials; lower preocular touches two labials.

FAMILY LEPTOTYPHLOPIDAE

A single genus of this family of diminutive snakes is known to occur in Costa Rica.

Genus LEPTOTYPHLOPS Fitzinger

Leptotyphlops Fitzinger, Systema Reptilium, 1843, p. 24.

Genotype: *Leptotyphlops nigricans.*

One species, *Leptotyphlops albifrons*, occurs in Costa Rica. It is a widespread form that, as now understood, extends throughout much of Central America and over a considerable area in northern South America.

Leptotyphlops albifrons (Wagler)

Stenostoma albifrons Wagler, *in* Spix, Serp. Brasil sp. nov., 1824, p. 68, pl. xxv, fig. 3; Duméril and Bibron, Erpétologie Générale. . . . . 1844, vol. 6, p. 327.

Leptotyphlops (= *Glauconia*) *albifrons* Wettstein, Sitz. Akad. Wiss. Wien Math.-Naturw. Klasse, Abt. 1, Bd. 143, Heft 1-2, 1934, p. 31 (Guanacaste: Bebedero).

This tiny, wormlike snake may be readily recognized by the brown coloration, somewhat lighter on venter than on back, each scale with darker edges, the color tending to form indistinct lines; a cream-white spot on top of head; lips and end of tail white.

Snout rounded; supraocular present, large, in contact or not with first labial; rostral scarcely reaching back to level of eyes, which are distinguishable under the ocular scale; nasal completely divided; ocular bordering lips between two labials; six infralabials; 14 scale rows around the body, lacking distinguishable ventrals;

body diameter 45 to 55 times in head-body length; tail in total length 15-21 times. Total length, 275 mm.

In Costa Rica the species is known from Bebedero, in the low area in Guanacaste. I have not examined any Costa Rican specimens.

FAMILY BOIDAE

Three genera of this family are known to occur, each represented by a single known species. These may be identified by the following synopsis.

KEY TO COSTA RICAN SPECIES OF BOIDAE

1. Small snakes, probably less than one meter in length; ventrals 260; subcaudals 82; scale rows about middle of body, 54; nasals separated by a pair of small internasals; usually two or three enlarged loreals with the same number of smaller scales below them; 12 scales between eyes. Ash colored with darker oval figures on either side ..... *Boa annulata*
   Large snakes from two to four meters in length 2
2. 61-79 scale rows around body; ventrals 225-252; subcaudals 47-65; 15-18 scales between eyes. Pale brown with numerous dark brown crossbars or blotches each usually with a pair of cream-colored dashlike marks; a dark line in middle of head and neck ..... *Constrictor constrictor imperator*
   Scales 45-51 about body; ventrals 233-238; subcaudals 55-58; 2 enlarged supraoculars separated by 4-6 scales; usually an enlarged loreal, with one or two smaller below it; a pair of normal internasals and a pair of normal prefrontals. Nearly uniform brown in color, the spots obsolescent or absent.... *Epicrates cenchria maurus*

Genus BOA Linnaeus

Boa Linnaeus (*part*), Systema Naturae, vol. 1, 1766, p. 373; Wagler, Natürliches System der Amphibien, 1830, p. 169.

Genotype: *Boa canina* Linnaeus.

One species occurs in Costa Rica.

Boa annulata (Cope)

Xiphisoma annulatum Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1875, p. 129, pl. 28, fig. 6 (type locality, Costa Rica); Bocourt. Etudes sur les reptiles; Mission scientifique au Mexique et dans l'Amérique Centrale, livr. 8, 1882, pp. 526-527, and livr. 9, 1883, pl. 31, fig. 4, 4a.

Corallus annulatus Boulenger, Catalogue of the Snakes in the British Museum, vol. 1, 1893, p. 102.

This small boa may be recognized by the following characters: Body strongly compressed, nearly three times as high as wide; scales in 42 rows on anterior part of neck, 54 near middle of body; top of snout covered with small scales, of which two, a little larger than the rest, separate the nasals and border the rostral. Top of head covered with small smooth scales, twelve to fourteen rows between eyes; no enlarged supraoculars; supralabials 15-15, the eighth to twelfth strongly pitted on the sutures; 18-19 infralabials, the ninth

to seventeenth pitted; six scales in loreal region; four supraoculars; four postoculars; two suboculars; one or two preoculars; one series of scales separates the orbit from the labials and bounds the labial pits. Ventrals 260; anal single; subcaudals, 82.

A Harvard M. C. Z. specimen (No. 37862 from Costa Rica [no specific locality]) has the head, in front of eyes, covered by some 40 small scales; eye bordered by 12 scales, the preocular largest; nasal divided; six scales occupy the loreal region; rostral higher than wide; chin shields small, scarcely distinguished from adjoining chin scales, the first pair touching only two labials. The second row of scales, back from eye border, is somewhat enlarged. Anteriorly the pattern consists of some H-shaped median dark spots between which are elongate oval fawn lines; the sides of H's tend to separate forming paired lateral spots having light centers and dark edges which may be opposite each other or alternate, or again may be joined mesially. The pattern tends to darken and become indefinite in old specimens.

The species has been recorded in Costa Rica from Ontario Farm and La Castilla on the lower Reventazón River, and Limón. The type specimen has been examined. It is from the Caribbean slope in the southeastern part of the country.

Genus CONSTRICTOR Laurenti

Constrictor Laurenti, Specimen medicum exhibens Synopsin Reptilium emendatum, 1768, p. 107.

Genotype: *Constrictor formosissimus.*

A single representative of this genus of boas occurs in Costa Rica. It is the largest snake known in the fauna.

Constrictor constrictor imperator (Daudin)

Boa imperator Daudin, Histoire Naturelle . . . reptiles, vol. 5, 1803, pp. 150-152 (type locality, Mexico).

Constrictor constrictor imperator Ihering, Rev. Mus. Paulista, vol. 8, 1910, p. 321.

One large specimen, M. N. H. No. 25754, was taken on the I. A. I. A. farm about three kilometers southwest of Turrialba and presented to me by the several workmen who captured the specimen. It measures a little less than 6 feet in length. The scale formula is 60-70-65-37; ventrals 243, subcaudals 67 (several near vent divided); anal single but greatly narrowed as are the three ventrals preceding anals; spots on body, 21½; on tail 4½ with extreme tip black; supralabials 23-22; infralabials 24-25; 17 scale rows between eyes.

This snake is common in the lowland areas in Costa Rica, and reaches elevations up to 3000 feet and perhaps somewhat higher.

Genus EPICRATES Wagler

Epicrates Wagler, Natürliches System der Amphibien, 1830, p. 168.

Genotype: *Epicrates cenchris* Wagler.

Epicrates cenchria maurus Gray

Epicrates maurus Gray, Catalogue of the Specimens of Snakes in the collection of the British Museum, 1849, p. 96 (type locality, Venezuela).

Epicrates cenchria maurus Stull, Proc. Boston Soc. Nat. Hist., vol. 40, no. 8, 1935, p. 396.

Epicrates cupreus var. *concolor* Bocourt. Etude sur les reptiles; Mission Scientifique au Mexique. . . . Livr. 8, 1882, pp. 525-526, pl. 31, fig. 3, 3a (part). (Costa Rica.)

Generally similar to *Epicrates cenchria cenchria.* Snout covered with regular scales but frontal and parietal areas covered with small irregular scales; the elongate loreal touching first labial but separated or not separated from second and third by small scales; supraoculars usually present but may be broken into more than a single scale; two preoculars, four or five postoculars; shallow pits present in upper and lower labials. Scales in 45-48 rows around body; ventrals 233-238 subcaudals 55-58, single; length (of a Costa Rican specimen) 1300; tail 157.

Uniform brownish, the dorsal spots almost, or entirely, obsolete.

FAMILY COLUBRIDAE

Four subfamilies are being recognized. These are the Natricinae, Sibynophiinae, Acrochordinae, and Colubrinae. It is probable that the Colubrinae as here considered is divisible into several subfamily groups. However, owing to the inadequate knowledge of the anatomy of several genera, I am not recognizing certain of such groups that have been proposed (*i. e.*, Xenodontinae, Dipsadinae, Boiginae, Dromicinae, Leptognathinae, Erythrolamprinae, Scytalinae, etc.).

The Natricinae, Sibynophiinae and Acrochordinae are represented each by a single genus, while no less than 28 genera are included in the Colubrinae as here considered.

SUBFAMILY ACROCHORDINAE

This small subfamily has one or two Asiatic genera and a single genus, *Nothopsis*, in the Western Hemisphere.

Genus NOTHOPSIS Cope

Nothopis Cope, Proc. Acad. Nat. Sci. Philadelphia, Oct. 24, 1871, p. 201.

Genotype: *Nothopsis rugosus* Cope.

Two species have been described in the genus. These are *Nothopsis rugosus* Cope from Darien and *N. affinis* Boulenger from

Salidero, N. W. Ecuador. A third form is here described as *torresi* from Turrialba, Costa Rica. The range of the genus is from Costa Rica to Ecuador.

Nothopsis torresi sp. nov.

Plate I

Type.—University of Kansas Museum of Natural History No. 28719; taken at the Morehead Finca, 5 miles southwest of Turrialba, Costa Rica, July 16, 1947, by Edward H. Taylor.

Diagnosis.—A small snake, heavily keeled, the scales in 26 or 25 rows about middle of body; outer edges of smooth ventrals turned up and finely striated, as are the lateral scales; body strongly compressed; nasal very large, single, with an entrant suture; two internasals; prefrontal area covered with 20-25 small granular scales; supraoculars large or divided, separated from single frontal by a row of small scales; large parietals present with a lateral entrant suture tending to separate the posterior parts from the main scale; eight rows of temporals; five postoculars, labials separated from the eye by two rows of small scales; four or five preoculars, one enlarged; ventrals 149; subcaudals 71; eighteen maxillary teeth.

Description of type.—Rostral nearly triangular, somewhat concave, directed upward and forward, barely visible from above; a pair of enlarged internasals, narrowed anteriorly, touching rostral, a little longer than wide, in contact for three fourths of their length; a small pair of scales following internasals somewhat larger than granular scales that separate them; remainder of area, usually occupied by prefrontals in most snakes, broken up into numerous (approximately 20) keeled scales, two of which are rounded and symmetrical, separated from each other and frontal; supraocular small, posterior part wider than anterior, separated from frontal and parietals by a single row of scales; frontal about as wide as long, its edges irregular, with a short suture entering from the front; parietals each nearly as large as frontal, their edges irregular; a pair of "postparietal" scales following, partly fused to parietals.

Nasal large, smooth with a depressed area, in which nostril is pierced; a suture from lower part of scale partly divides it; a flaplike valve? present in nostril; area between nasal and eye occupied by a number of smooth scales, one somewhat enlarged touches two labials and nasal, and another enlarged one enters border of eye as a preocular; four other granular preoculars and five postoculars present; one or two rows of suboculars separate the labials from the

PLATE I. *Nothopsis torresi sp. nov.* Type. MNH No. 28719, Morehead Finca, 5 miles southwest of Turrialba, Costa Rica; total length, 401 mm.

orbit; temporal region with eight rows of small keeled scales between labial and parietals; 9-10 supralabials, smooth save for the upper edges of the posterior scales which are striate. Mental triangular, narrower than rostral; first infralabials in contact behind mental; 12-13 infralabials, but posterior scales partly fused together (two on right side, four on left); a single pair of chinshields; about ten small scales separate chinshields from first ventral.

Scales heavily keeled on body, less so on head; scale rows around back of head, 39; narrow part of neck, 26 (25); 26 (25) about middle of body; 22 in front of anus; five or six median scale rows larger than lateral scales; ventrals 149; anal single; subcaudals 71, divided, except first; terminal spine of tail directed somewhat down at tip and partly scaled dorsally.

Eye small, about 2 1/5 times in its distance from nostril.

Color.—Head black; labials fawn; chin cream; dorsal ground color lavender-brown, growing lighter low on sides; a series of about thirty-two saddlelike, rather irregular, dark blotches which widen laterally and are in contact with each other on anterior half of body; posteriorly they may be together or they may fail to touch dorsally; a series of somewhat more discrete dark spots are immediately below the saddles; numerous scattered dots on fawn-colored ventrals; pattern continued on tail, but much reduced; scales bordering ventrals on sides of neck nearly white; beginning in the occipital region are two very short cream lines, which are separated by a median black area five or six scales in width.

Measurements in mm.—Head length, 13; greatest width of head, 7; width at eyes, 5; total length, 401; tail, 117; body, 284.

Teeth.—Eighteen (17) maxillary teeth all bent back strongly, increasing a little in size from fore to aft, then followed after a short diastema by two larger, heavier teeth.

Relationships.—Two species of the genus are known—*Nothopsis rugosus* (type) and *Nothopsis affinis*. The present form may be distinguished by the presence of an even or odd number of scale rows; the reduction of the scales about the middle of body and the increase in the number of maxillary teeth, approximately 18 instead of 12.

When Boulenger described his *Nothopsis affinis*,* he had before him a specimen of *Nothopsis* from Carriblanca, Costa Rica, which he identified as *Nothopsis rugosa* Cope, a species whose type locality is "Isthmus of Darien." *N. affinis* is reported as having 27 scale rows

* Ann. Mag. Nat. Hist., (ser. 7) vol. 15, 1905, p. 453.

and the type of *rugosa* has 29. The species here described has a pair of median scale rows which at intervals are fused on the median line in series of two to five scales. Consequently, the count is 26 scales where the median scales are not fused, 25 where they are fused.

Whether Boulenger's Carriblancan specimen is actually a member of the species here described cannot at this time be determined.

Remarks.—Part of the scales on the head are smooth and shining (rostral, nasals, internasals, scales in loreal region for the most part, and labials). It is possible, but I think not probable, that this is due to wear. The other scales have heavy keels and the scale surface is very finely roughened by what appear to be extremely numerous fine keels or striations.

I collected the specimen at night quite by accident, when I grabbed at a small anole in a pile of leaves on the ground, near the edge of a swampy area in the forest. The specimen made no attempt to bite.

The following table presents in tabular form the differences in the three species.

COMPARATIVE DATA ON SPECIES OF NOTHOPSIS

	Ventrals	Sub-caudals	Scale row	Supra-labials	Maxillary teeth	Total length	Tail
rugosa.....	158-161	97-100	28-30	12	12	381	?
affinis.....	162	98	27	10	?	320	100
torresi.....	149-153	71-92	(25-26)	9-10	18	401	117

The species is dedicated to Sr. Prof. Rubén Torres Rojas, noted educator and scientist of Costa Rica, and my official host in the country.

I have examined a female specimen from the Reventazón Valley (M. C. Z. Harvard No. 15269) which I have referred with a question to *Nothopsis torresi.* It differs from the type in that there is no tendency of the two median dorsal scale rows to fuse, the formula being 26-26-22. Some of the characters of this specimen are: 25 small scales on the top of rostrum, those following internasals somewhat larger and regular; the supraoculars are broken into two or three scales, separated from the frontal by a row of small scales; the frontal has a groove causing it to appear paired; parietals large, separated mesially by small granular scales; supralabials 10-10; infralabials 11-13; ventrals 153; anal single; subcaudals 92.

I have compared the new form with a specimen of *N. rugosa* Cope from Panamá. This specimen has the scale formula 30-28(29)-26; ventrals 161; subcaudals 97.

Subfamily Sibynophiinae

A single generic representative of this subfamily, *Scaphiodontophis*, is known in the Western Hemisphere.

Genus Scaphiodontophis Taylor and Smith

Scaphiodontophis Taylor and Smith, Univ. Kansas Sci. Bull., vol. 29, pt. 2, 1943, pp. 302-304, fig. 1.

Genotype: *Enicognathus annulatus* Duméril, Bibron and Duméril.

Only a single species of this genus has been reported from Costa Rica. The range of the genus extends from northern Veracruz in Mexico to Colombia.

Scaphiodontophis venustissimus (Günther)

Hemicognathus venustissimus (Günther, Biologia Centrali-Americana, Reptilia and Batrachia, Oct. 1894, p. 144, pl. 51, fig. C (type locality, Matagalpa Hda. Rosa de Jerico [3250 ft.], Nicaragua).

Sibynophis venustissimus Dunn, Occ. Papers Boston Soc. Nat. Hist., vol. 5, 1930, p. 330 (incorrectly attributes the spelling of this name by Günther as *venistussimus;* perhaps a *lapsus mentum*) (Zent, Costa Rica).

Scaphiodontophis venustissimus Taylor and Smith, Univ. Kansas Sci. Bull., vol. 29, pt. 2, 1943, pp. 309-311, fig. 5.

The species may be distinguished by the following diagnosis: frontal as long as its distance to rostral or a little longer; loreal rhombic; one preocular; two postoculars, both touching parietal; temporals 2 + 2 or 1 + 2; supralabials nine, the fourth, fifth and sixth entering orbit; chinshields of both pairs about same length, the anterior the larger; scales in 17-17-17 rows, smooth; ventrals 137-152; anal divided; subcaudals 96+; maxillary teeth small, 43-56 in a continuous series.

Coral (or reddish olive) above, with 8-11 white-edged, transverse, black bands, which terminate at the ventrals, these often broken and alternating; top of head generally whitish from rostral to anterior part of parietals with an indistinct smoky spot on snout; this followed by a yellow transverse band to near posterior end of parietals, and this in turn followed by a black band, and a white band across neck five scale rows back of parietals. Upper labials, chin and venter whitish but with some pigmentation forming indistinct spots on the edges of ventrals; each subcaudal with a large black spot. Red scales with black tips.

I have examined the following Costa Rican specimens: M. C. Z. No. 15308, Bonilla, Costa Rica; M. C. Z. No. 15272, Zent, Costa Rica; and U. S. N. M. No. 67350 from Columbaria, Costa Rica.

In the latter specimen the snout is blackish or blackish brown but the interorbital region is somewhat lighter. This is followed by a large black spot occupying the posterior three fourths of the parietals and the first six or seven scale rows on neck. The body has red bands separated by eight white-black-white triads (four of which are broken mesially, the halves alternating). Ventrals 152; the tail is injured, the tip missing.

SUBFAMILY NATRICINAE

Only one genus, *Thamnophis,* reaches Costa Rica.

Genus THAMNOPHIS Fitzinger

Thamnophis Fitzinger, Systema Reptilium, 1843, p. 26.

Genotype: *Coluber sauritus* Linnaeus.

Thamnophis sirtalis chalceus* (Cope)

Prymnomiodon chalceus Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 12, 1860 (1861), p. 558 (type locality "Siam" in error).
Thamnophis sauritus chalceus Dunn, Herpetologica, vol. 1, 1940, pp. 192-193.

The genus *Thamnophis* has numerous species and subspecies in the United States, and the number of forms becomes even larger in Mexico. The Isthmus of Tehuantepec limits the greater number of these, and the range of only one is known to reach southward as far as Costa Rica.

The single specimen at hand, M. N. H. No. 25679, is one collected by Sr. Rubén Torres Rojas and Sr. Marco Tullio Pacheco about two miles south of Cartago. This specimen, which the collectors presented to me, has the following characteristics:

Rostral once and one-third times as wide as high; internasals as long as the prefrontals; latter nearly one third wider than long; frontal more than one fourth wider than long, the length more than one fifth greater than its distance from tip of snout; length of parietal one sixth longer than the frontal, equal to its distance from the internasals; nasal divided, touching two supralabials; loreal about as long as high or a little longer; preoculars, 1-1, two to three times as high as wide, rather narrowly separated from the frontal; postoculars 2-3 (on one side the two lower scales are almost completely fused); temporals $1 + 2 + 1$ $(1 + 2 + 2)$; supralabials 8-8, the fourth and fifth bordering eye; infralabials 10-10, five bordering first chinshields; second pair of chinshields longer than first pair, separated by small scales.

* Klauber has suggested that *sirtalis* as a species name applies to this species. Copeia, No. 1, 1948, pp. 8-10.

Scales finely corrugated or striate, each bearing a strong keel, and a small terminal notch. The scale formula is 19-17-17; ventrals 156, subcaudals 88; anal single. In life the specimen was olive, with a dim median line, and a very dim line on the third and fourth scale rows.

The specimen was taken near a shallow pond on which water hyacinths were floating.

I have also examined U. S. N. M. No. 38149 from San José, Costa Rica. The following scale characters were recorded: scale formula 19-19-19-17, all rows keeled; ventrals 151; subcaudals 84; one preocular touching frontal on one side, not on other; two-three postoculars; loreal present; nasal divided; a small entrant suture in the frontal; temporals 1 + 2 + 2; 8-8 supralabials, the fourth and fifth entering orbit; 10-10 infralabials, five touching the first pair of chinshields, which are shorter than second pair and separated by a small scale.

A median dark-edged light line present on back begins between parietals; two small spots present on parietals.

SUBFAMILY COLUBRINAE

Twenty-nine genera are treated under this subfamily.

KEY TO THE GENERA OF THE COLUBRINAE

1. Nasal scales in contact behind rostral (rarely very narrowly separated); nostril directed upward 2
   Nasal scales not in contact behind rostral, the nostril directed outward laterally... 3
2. Internasals fused into a single scale behind nasals.....*Helicops*
   Internasals not fused into a single scale.....*Tretanorhinus*
3. Prefrontals fused into a single scale..... 4
   Prefrontals not fused into a single scale..... 5
4. Nostrils in a single nasal scale directed upward; large snakes (900 mm.); coloration uniform .....*Hydromorphus*
   Nostrils in at least semidivided nasals, directed laterally; small snakes, less than 300 mm.; (part of genus only).....*Trimetopon*
5. Lacking a median mental groove, the chinshields transversely arranged; a loreal and preocular both entering orbit; four postoculars.....*Neoparias*
   A median mental groove present; the chinshields longitudinally placed..... 6
6. The maxillary teeth nearly equal without posterior enlarged fangs, or the size reducing posteriorly 7
   Maxillary teeth increasing in size, the last one or two somewhat fanglike not grooved and may or may not be separated from the series by an interval..... 14
7. Anal plate single..... 8
   Anal plate double.....*Elaphe*
8. No preocular; loreal and prefrontal bordering orbit of eye..... 9
   A preocular, the loreal and prefrontal separated from orbit..... 12
9. No anterior temporal.....*Geophis*
   Anterior temporal present..... 10
10. Scales 17-21 rows, strongly keeled.....*Ninia*
    Scales 15-13 rows, smooth..... 11
11. Teeth diminishing in size posteriorly.....*Sibon*
    Teeth not diminishing in size posteriorly.....*Dipsas*

12. Scales smooth; scale formula 19, 19(21)-17 ..... *Drymarchon*
Scales keeled 13
13. Four median scale rows keeled; scale rows uneven; scale formula 21-25-15... *Pseustes*
Dorsal scales, save outer row, keeled; scale rows in even numbers 14(16)-16-10 ..... *Spilotes*
14. Posterior fanglike teeth separated from other maxillary teeth by a toothless interval 15
Posterior enlarged teeth of maxillary series not separated by a toothless interval from the remainder of the maxillary teeth 17
15. Body slender, the tail 30-39% of total length; small snakes; four or five maxillary teeth followed by fang ..... *Enulius*
Tail less than 25% of total length 16
16. Scales arranged in oblique transverse rows; large thick-bodied snakes, length one meter or more) ..... *Xenodon*
Scales not arranged in oblique rows; smaller snakes, 800 mm ..... *Leimadophis*
17. No loreal present, tail one third total length; scales 17 rows, faintly keeled posteriorly ..... *Amastridium**
Loreal present 18
18. Scales about body in even numbers ..... *Chironius*
Scales about body in odd numbers 19
19. No apical pits present 20
Apical pits present 21
20. Body banded black and red or black, yellow and red (the red and yellow fading in preservative to cream or white ..... *Pliocercus*
Body not banded; pattern, if present, of dark and light stripes or lines .... *Rhadinaea*
21. Eye with elliptic pupil ..... *Hypsiglena*
Eye with round pupil 22
22. Diminutive snakes probably not exceeding 250 mm. in length; scales in 15 rows (part of genus only) ..... *Trimetopon*
Medium to large snakes, all reaching 700 mm. or more in length 23
23. Body black crossed by whitish lines; belly yellow or coral red with transverse black spots (*cobella*) ..... *Liophis*
Not so marked 24
24. Body banded in red, black and yellow or these bands tending to become obscured (darker) ..... *Lampropeltis*
Not so marked 25
25. Four black longitudinal stripes; rostral projecting, part visible above about half distance to frontal ..... *Salvadora*
Not so marked 26
26. Scales smooth 27
Scales keeled 28
27. Scales in 17-17-15 rows; 9 supralabials ..... *Dryadophis*
Scales in 17-15-13 rows; 7 or 8 supralabials ..... *Masticophis*
28. Scales in 17 rows around body 29
Scales in 15 rows reducing to 11 in front of anus ..... *Thalerophis*
29. Maxillary teeth generally more than 33 ..... *Dendrophidion*
Maxillary teeth generally less than 33 ..... *Drymobius*

Genus GEOPHIS Wagler

Geophis Wagler, Natürliches System der Amphibien, 1838, p. 194.

Genotype: *Catostoma chalybeum* Wagler.

Six species are recognized as occurring in Costa Rica.

KEY TO COSTA RICAN SPECIES OF GEOPHIS

1. Scales smooth in 17 rows, no supraocular; ventrals 135-141; subcaudals 30-43 *rhodogaster*
Scales in 15 rows, smooth or partly keeled; supraocular present or absent 2

* (*Mimetopon sapperi* Werner, sometimes placed in the genus *Amastridium* is reputed to have a minute groove visible at a magnification of 80 diameters.

2. Scales smooth; no supraocular; ventrals 144-145; subcaudals 27-28. Blackish brown above, yellowish or whitish below; a few transverse blotches under tail occasionally present on posterior part of belly.....*godmani*
Scales at least partially keeled; a small supraocular present..... 3
3. Scales keeled at base of tail; supralabials five (rarely six); ventrals 129-133, subcaudals 31-36; black above, below brownish yellow or whitish; a light nuchal band in young.....*hoffmanni*
Scales keeled and striate on at least one third or more of body and tail; color variable; supralabials six..... 4
4. Large red spots alternating or opposite on sides of body; ventrals 131-138; subcaudals 39-46; scales striated and strongly keeled on posterior half of body; head narrow elongate .....*dolichocephala*
No large red spots on sides of body; scales striate and keeled on greater part of body 5
5. Infralabials 7; ventrals 131-140; subcaudals 32-39; blackish with a dim nuchal collar; venter whitish with some pigment extending onto ventrals (rarely nearly across) .....*moesta*
Infralabials 6 (7); ventrals 143-144; subcaudals 34-35. Black with a narrow lateral orange stripe; venter smoky black, each scale with a lighter edge..*brachycephala*

[*Geophis rhodogaster* (Cope)]

Calophrys rhodogaster Cope, Proc. Acad. Nat. Sci. Philadelphia, Mar. 1868, p. 130, fig. ("Neighborhood of the city of Guatemala").

Geophis rhodogaster Bocourt, Etudes sur les reptiles; Mission Scientifique au Mexique et dans l'Amérique Centrale, livr. 9, 1883, p. 531, pl. 31, fig. 12, a-e; Boulenger, Catalogue of the Snakes in the British Museum, vol. 2, 1894, p. 317.

Eye small, measuring two thirds to three fourth its distance from mouth; snout rounded, feebly projecting; rostral moderate, slightly broader than deep, the part visible from above about one third its distance from the frontal; internasals nearly twice as broad as long, one half to two fifths of the length of the prefrontal; prefrontals broader than long; frontal broader than long, as long or a little longer than its distance from the end of snout; a little shorter than parietals; no supraocular; frontal bordering eye; loreal nearly twice as long as deep; one postocular; six supralabials, third and fourth bordering eye; three infralabials border first chinshields, which equal or are longer than the posterior, separated from mental; scales in 17 rows, perfectly smooth; ventrals 135-144; anal single; subcaudals 30-43.

Uniform dark brown above; upper lip, outer row of scales and lower parts uniform orange.

The species is reported from Costa Rica by Boulenger, *loc. cit.* Günther (Biologia Centrali-Americana; Reptilia and Batrachia, 1893, pp. 87-88) mentions a specimen in Smithsonian Institution as a basis for a Costa Rican record. Boulenger, *op cit.*, also gives Costa Rica as within the range of *rhodogaster*, perhaps on the basis of Günther's statement. I regard the record as somewhat doubtful.

Geophis godmani Boulenger

Geophis godmani Boulenger, Catalogue of the Snakes in the British Museum, vol. 2, 1894, p. 322, pl. 16, fig. 4 (type locality, Irazú, Costa Rica); Dunn, Notulae Naturae, no. 108, 1942, p. 4.

Eye small, a little shorter than its distance from the mouth; snout obtusely pointed, very prominent; rostral rather large, a little higher than broad, the portion visible above measuring two thirds to three fourth its distance from frontal; internasals a little broader than long, half as long as the prefrontals, which are a little longer than broad; frontal as long as broad, as long as or a little shorter than its distance from end of snout, shorter than parietals; no supraocular; prefrontal forming a narrow suture with the parietal between frontal and eye; loreal once and a half times as long as broad, entering orbit; a minute postocular; six supralabials, the third and fourth entering orbit; three infralabials touching chinshields which are not longer than posterior and are separated from mental; scales in 15 rows, all perfectly smooth; ventrals 144-145; anal single; subcaudals 27-28. Uniform blackish brown above, yellowish beneath; a few transverse brown blotches under tail, sometimes also on belly. Total length, 400 mm.; tail, 55 mm.

Known in Costa Rica from the type locality, Volcán Irazú; from Escazú, and Tierra Blanca.

Geophis hoffmanni (Peters)

Plate II, figs. 1-2

Colobognathus Hoffmanni Peters, Monatsb. Akad. Wiss. Berlin, 1859, p. 276, pl., fig. 2-2c (type locality, Costa Rica).

Geophis hoffmanni Bocourt, Etudes sur les reptiles; Mission Scientifique au Mexique et dans l'Amérique Centrale, livr. 9, 1883, pl. 31, figs. 8, 8a-c; Dunn, Notulae Naturae, no. 108, 1942, p. 4 (mentions 40 Costa Rican specimens, from 11 localities; also specimens from Boquete, Panamá).

Four specimens of *Geophis hoffmanii* were collected: Two on the Pacific drainage near San Isidro El General, and two in the Central Plateau: one at Turrialba and one at Cartago.

Description from No. 1032.—Portion of rostral visible above, a

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PLATE II

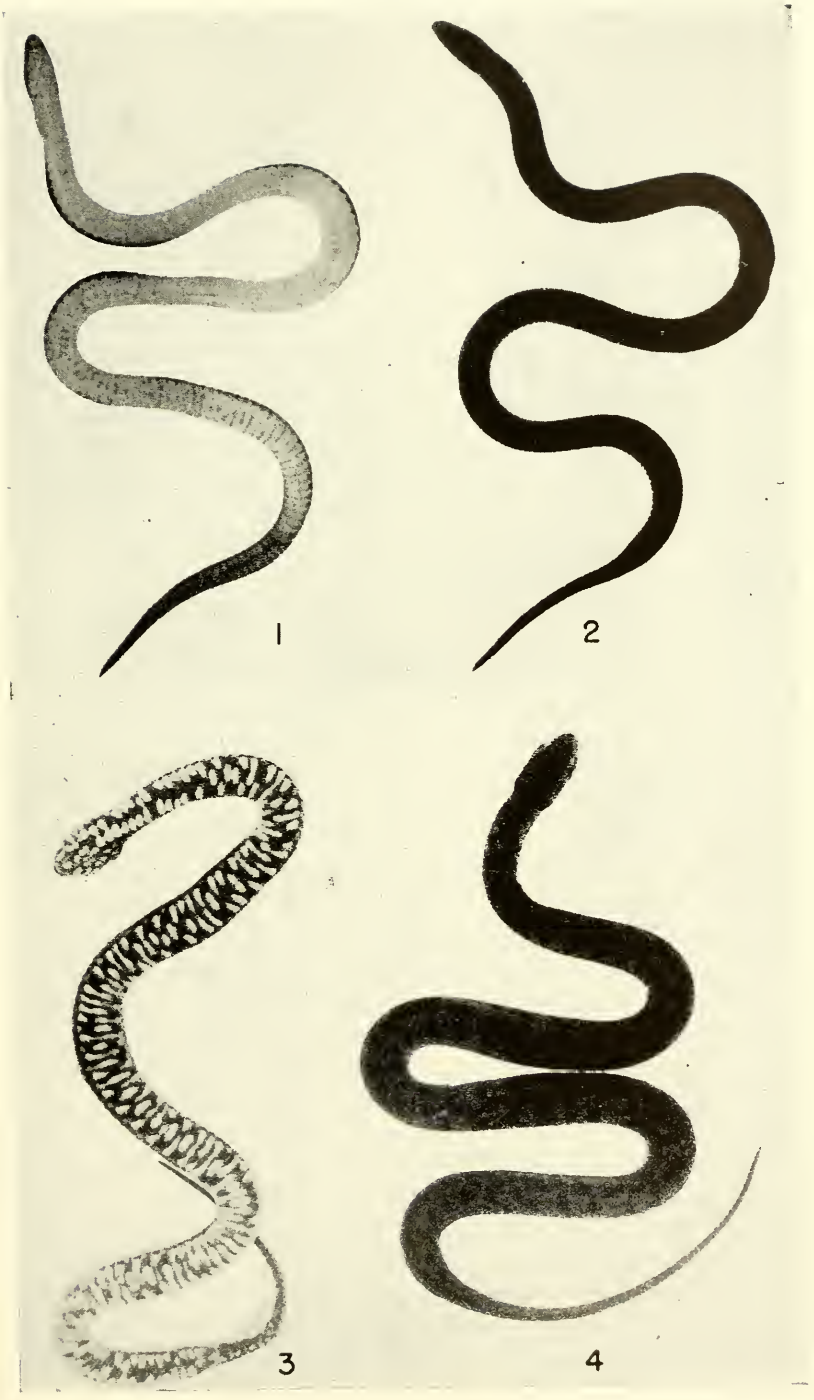
FIG. 1. *Geophis hoffmanni* (Peters), RCT No. 346, Turrialba, Costa Rica, July 13, 1945; total length, 201 mm. Ventral view.

FIG. 2. *Geophis hoffmanni* (Peters), MNH No. 1032, San Isidro El General, August 22, 1947; total length, 192 mm. Ventral view.

FIG. 3. *Ninia tessellata* (Peters), RCT No. 1445, Los Diamantes, Costa Rica, September 1-8, 1947; total length, 233 mm. Ventral view.

FIG. 4. *Ninia tessellata* (Peters), RCT No. 1364, Los Diamantes, Costa Rica, September 1-8, 1947; total length, 279 mm.

PLATE II



little larger than an internasal; nostril between two subequal nasal scales; internasals small, about one fifth as long as the prefrontals, and about one sixth their area; frontal six-sided, its width minutely greater than its length, its length about one-seventh longer than its distance from tip of snout; length of parietal equal to its distance from the rostral; loreal elongate nearly twice as long as high entering orbit; supraocular small, scarcely larger than postocular; no preocular, one postocular; no anterior temporals, the fifth (and last) labial broadly bordering the parietal; five supralabials, the third and fourth border eye; six infralabials, the first three border the first chinshields; these equally as long as second pair; second chinshields partly separated by a large scale.

Scale formula, 15-15-15; all smooth except at the base of the tail, at which point the scales are small (15 scale rows) and keeled (in both sexes); ventrals, 133 (2 small scales between ventrals and chinshields); subcaudals, 31; anal single.

Total length, 192 mm.; tail, 29 mm.; width of head, 3.5 mm.; length of head to end of parietals, 6 mm.

The color in life is generally bluish black, more or less iridescent on dorsal and lateral surface of body and head; no neck band; ventrals flesh white, the white extending onto the outer scale row, for the most part covering less than half the scale row; a peppering of smoky black pigment on the ventrals usually extending across the outer third on each side; darker under the tail but some light color on each subcaudal.

The other specimens differ but little in color from the one described. One specimen has the ventrals without pigment for nearly two thirds the length of the body. In another, smoky pigment encroaches on the white part of the first scale row. The squamation of the specimens is very uniform. All have the scales smooth save at the base of the tail where there are 15 keeled scale rows reduced in size. The scale formula is the same in all. The relation of the two pairs of chinshields is the same, and a median scale tends to separate the posterior part of the second pair, both pairs being tubercular in males. Five is the constant number of supralabials, the last very large, broadly bordering the parietal. There are no primary temporals lying between the parietals and labials. One secondary temporal borders the parietal behind the fifth labial in all.

It would appear that these specimens, one from the Caribbean drainage (Turrialba No. 346) and two from the Pacific drainage (San Isidro El General No. 880, No. 1032) and one from the central plateau region (Cartago No. 1020), represent a species that shows

very little variation despite the diverse geographical areas it occupies. I have examined several Harvard specimens as follows:

A Harvard M. C. Z. specimen, No. 15304, from Navarro, Costa Rica has four supralabials, the third and fourth being fused; infralabials five; ventrals 134, subcaudals 29; lateral scales keeled at the base of the tail.

No. 15267 ♂, has five supralabials and six infralabials; a small supraocular present, not in contact with the small postocular; ventrals 126; tail broken; keels present at base of tail.

No. 15271 ♀, from La Palma, Costa Rica has the ventrals with brownish pigment tending to cross the ventrals; ventrals 133; subcaudals 28; keels near tail base scarcely indicated.

Nos. 19327 ♂ and 19328 ♀ from Suretka, Costa Rica, have respectively 124 ventrals, 37 subcaudals; 134 ventrals, 30 subcaudals. In the former specimen the loreal narrowly enters orbit; in the latter, it is excluded from orbit. Both specimens have five supralabials and six infralabials.

Two specimens in the U. S. National Museum are from Cartago and San José, Costa Rica.

Geophis dolichocephala (Cope)

Plate III, fig. 2

Colobognathus dolichocephalus Cope, Proc. Acad. Nat. Sci. Philadelphia, 1871 (Oct. 24), p. 211 (type locality, San José, Costa Rica).

Catostoma dolichocephalus Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1875, p. 147.

Elapoidis dolichocephalus Cope, U. S. Nat. Mus. Bull. no. 32, 1887, p. 85 (San José).

Geophis dolichocephalus Boulenger, Catalogue of the Snakes in the British Museum, vol. 2, 1894, pp. 320-321 (Cartago, Costa Rica).

Geophis brachycephalus (*part.*) Dunn, Notulae Naturae, no. 108, 1942, p. 5.

A specimen of this species (No. 25732) was taken in a pile of chips at the edge of a tiny rivulet on the Morehead finca, five miles southwest of Turrialba, Costa Rica.

Color brownish black above with a series of 21 brick-red blotches on each side. Anteriorly blotches scarcely distinguishable and separate; on the latter two thirds of the body they are confluent mesially or separated by a very narrow dark line. On sides the spots, which are rarely more than three scales long, reach to first scale row. A small red spot present near angle of jaw. Belly flesh white with some olive reflections; head blue-black with metallic reflections. The lower labials and chinshields black, and tail black without red spots. Caudals black with indefinite lighter areas on each scale. The dark color of sides extends onto ventrals a greater or lesser distance. Most scales of outer row have a narrow diagonal cream spot, which in the aggregate suggests a zigzag line.

The scale characters of this species follow: rostral visible above broader than high; internasals small, subtriangular, about one fourth the total length of the prefrontals, about one third of the median suture between prefrontals; frontal very broad, only minutely longer than broad, almost quadrangular; supraocular diminutive, as wide as long or minutely longer; parietals elongate, (4.8 x 3.3 mm.), shorter than their distance from snout tip; nasal divided, the nostril pierced chiefly in anterior part; an elongate loreal entering eye and replacing the missing preocular; a small postocular; no anterior temporal; one posterior temporal; 6 supralabials, the third and fourth entering the orbit; 7-7 lower labials, four touch first pair of chinshields; second pair of chinshields smaller than first; eyes small, contained in distance from snout tip about three and one-third times. Scales smooth or very finely striate on neck; striate and keeled over remainder of dorsal surface except outer enlarged scale row; scale formula, 15-15-15; ventrals 142; anal single, subcaudals 48. Total length, 359 mm.; total ventrals and subcaudals 190; snout to vent, 283 mm.; tail, 76 mm.; head length, 11.6 mm; head width, 6 mm.

The type of this form is described as having only 13 scale rows but Boulenger (*loc. cit.* footnote) states that Cope has checked the type and finds 15 scale rows present. The type has 131 ventrals, 39 subcaudals; total ventrals and subcaudals 170, which is 20 less than this specimen. Boulenger lists two specimens having ventrals 135, 138 and subcaudals ? and 46.

Geophis moesta Günther

Geophis moestus Günther, Ann. Mag. Nat. Hist., ser. 4, vol. 9, 1872, p. 15 (type locality, Cartago, Costa Rica); and Biologia Centrali-Americana, Reptilia and Batrachia, May 1893, pp. 90-91, pl. 33, fig. C.

Geophis hoffmanni Boulenger, Catalogue of the Snakes in the British Museum, vol. 2, 1894, pp. 319-320 (all or part).

Geophis brachycephalus part. Dunn, Notulae Naturae, no. 108, 1942, p. 4.

Dunn, *op. cit.*, has recently placed this form in the synonymy of *Geophis brachycephalus.* This I regard as an error since the species appear to be distinct.

The following are the characteristics of M. N. H. No. 25738 taken ½ mi. NE of Santa Cruz, south slope of Volcán Turrialba: scales 15-15-15; supralabials 6; infralabials 7-7; scales keeled throughout

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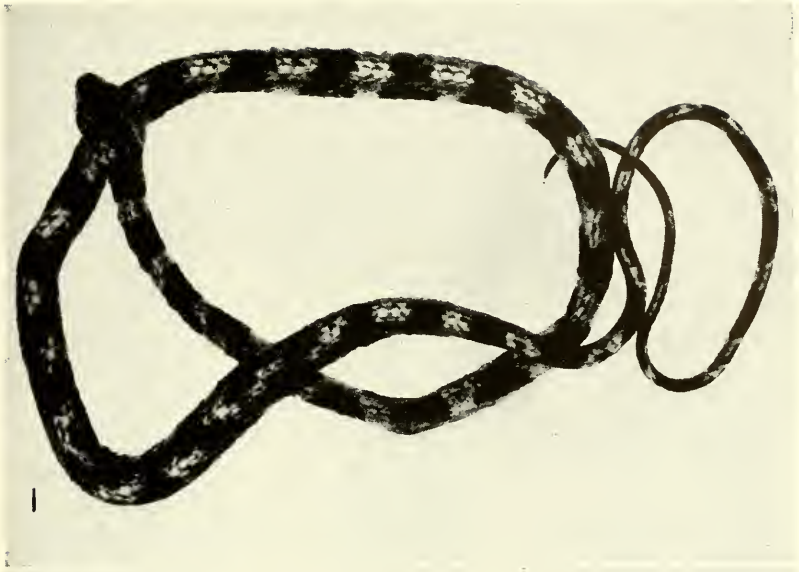
PLATE III

FIG. 1. *Dipsas annulata* (Günther), M.N.H. No. 25702, Isla Bonita, Costa Rica, August 5, 1947; total length, 501 mm.

FIG. 2. *Geophis dolichocephala* (Cope). M.N.H. No. 25732. Morehead Finca, 5 miles SW Turrialba, Costa Rica, July 14, 1947; total length, 359 mm.

PLATE III



1

2

latter three fourths of body; anterior chinshields larger and longer than posterior (or nearly of same size), which are partially or entirely separated by a median scale in one specimen. Ventrals, 131; subcaudals, 39; anal single. A black spot on anterior chinshields; supraocular present, twice as large as the single postocular; a light band across back part of head and anterior part of neck (tending to disappear in old adults); posterior nasal much larger than anterior; fifth labial touches parietal; one secondary temporal; three or four infralabials touch first chinshields.

A second female specimen (R.C.T. No. 839), from about one-half mile east of Santa Cruz, has 140 ventrals and 32 subcaudals. In this the infralabials are 7-6; the posterior chinshields are not separated and are only a little smaller than the first pair.

Both specimens are blackish with a dim nuchal collar, the venter being whitish with some dark pigment on outer edges of ventrals. Posteriorly in one specimen (No. 25738) the dark color extends almost across the ventrals; the subcaudals likewise blackish, each scale with a narrow transverse light line across the middle. There is a brownish area on the top of head. When submerged in water, No. 839 shows the outer borders of body scales slightly darker than their median parts. The infralabials are white in both specimens and some lighter color may be evident on the anterior scales of the outer row.

Geophis brachycephala (Cope)

Plate IV, figs. 2-3, text fig. 1

Colobognathus brachycephalus Cope, Proc. Acad. Nat. Sci. Philadelphia, 1871, p. 211 (type locality, Costa Rica).

Catostoma brachycephalum Cope, Journ. Acad. Nat. Sci. Philadelphia, 2d ser., vol. 8, 1875 and 1876, p. 147.

Dirosema brachycephalum Boulenger, Catalogue of the Snakes in the British Museum, vol. 2, 1894, p. 299.

*Geophis brachycephalus** (*part.*) Dunn, Notulae Naturae, no. 108, 1942, p. 4.

Two specimens of this rare snake were found under small logs on the side of Volcán Turrialba at an elevation of near 6000 feet, about three kilometers above the village of Santa Cruz. The general coloration is blue black with an orange-red lateral stripe (not of solid color) two or three scales wide anteriorly but posteriorly about one scale wide; venter dusky, each ventral scale lighter edged.

These specimens were coiled tightly, almost into a ball under the same logs as were found a number of leeches equally as large, or larger, black in color with red markings low on sides and in ventral

* Dunn includes *dolichocephalum*, *mocsta*, *quadrangularis* and *championi* as synonyms of this species.

regions. These were likewise coiled into a ball-like mass and occupying small excavations or depressions below the logs as were the snakes. In each case where a snake was found, one or more leeches was present. On superficial examination they are very similar to the snakes. Under some logs only the leeches were found, invariable rolled into a knotted ball-like mass. I found no evidence that the leeches preyed on the snakes. Since they are larger or equally as large as the snakes, I think it unlikely that the snakes use the leeches for food. However when placed in a sack, a leech fastened on one of the snakes. I regard this as a matter of chance.

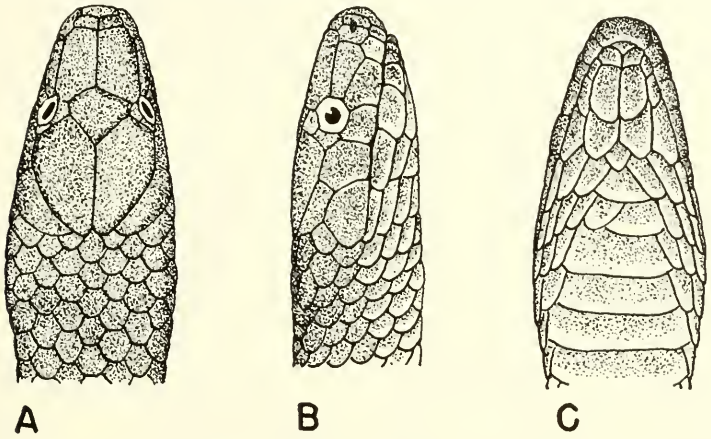


FIG. 1. *Geophis brachycephala* M.N.H. No. 25735. Collected 3 miles NE Santa Cruz, on the southern slope of Volcán Turrialba. A, Head, dorsal view; B, Head, lateral view; C, Head, ventral view. ×4.

The scale characters of the two specimens (R. C. T. No. 840 and M. N. H. No. 25735 respectively) are given: Scale formulae, both, 15-15-15; ventrals, 144, 143; subcaudals, 34, 35; anal, 1; no preoculars; postocular, 1-1; supraocular, 1-1; supralabials, 6-6; supralabials enter eye, 3, 4; infralabials, 6-6; touch chinshields, 3-3; total length and tail length, 245-35; 230-24.

Area of frontal visible above smaller than or nearly as large as an internasal; latter scales less than one third the length of the prefrontals; latter very large, about five times area of internasals; frontal hexagonal, about 1/6 wider than long, its length greater than its distance from tip of snout; parietals as long as their distance from the tip of the snout; nasal divided; no anterior temporal, the fifth labial bordering the parietal; one posterior temporal; loreal

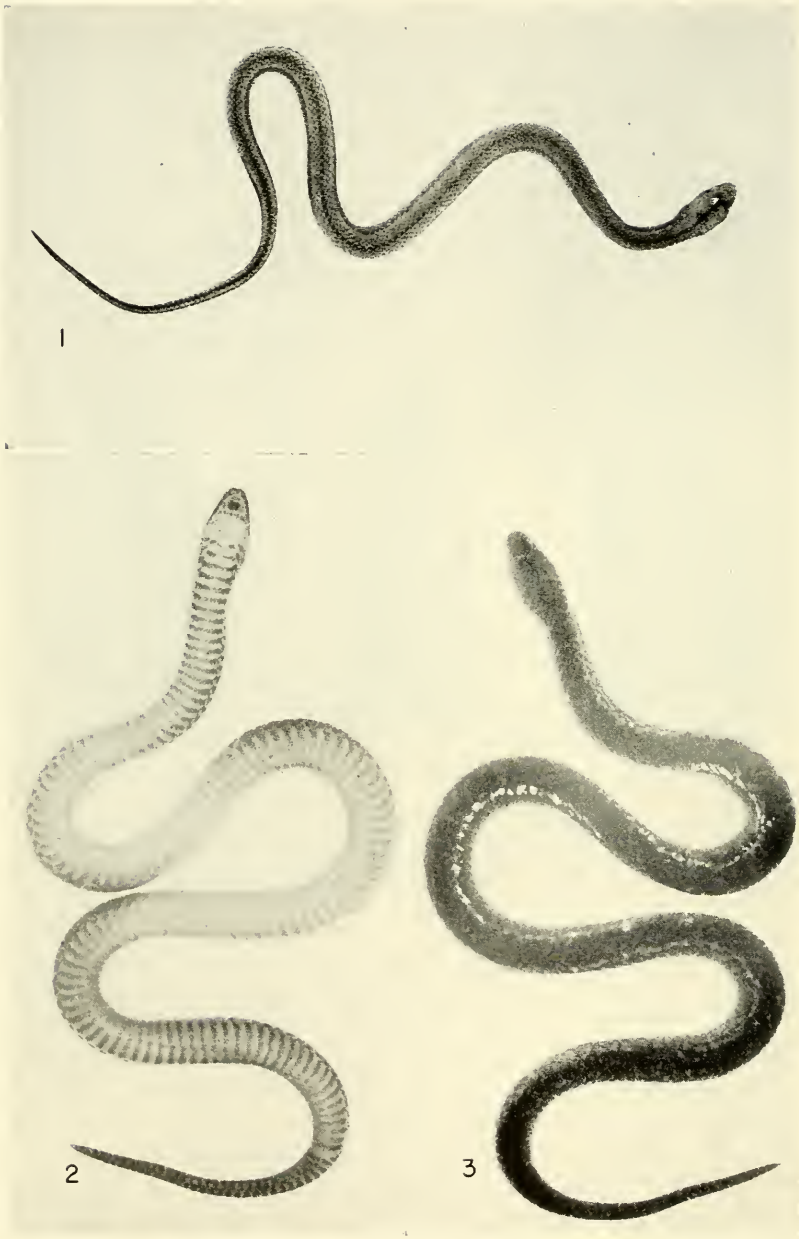


PLATE IV. Fig. 1. *Coniophanes fissidens punctigularis* Cope, Los Diamantes, 1 mile south Guápiles, Costa Rica, September 2, 1947; about natural size. RCT No. 1369.

Fig. 2. *Geophis brachycephala* (Cope), RCT No. 840, Volcán Turrialba, Costa Rica; elevation, approximately 6000 feet; total length, 245 mm. Ventral view.

Fig. 3. *Geophis brachycephala*. Same as fig. 2 dorsal view (retouched).

two, to two and one-half times, as long as high; first chinshields about as long as but larger than second pair (in one specimen distinctly longer); scales smooth anteriorly, keeled and finely striated on posterior half of body and tail.

Black above, with a salmon to orange-red lateral stripe made up of flecks, extending from neck to tail, but growing more faint posteriorly. The stripe covers much of the second and third rows but posteriorly it is on the third and fourth. Occasionally scales of the scale row above the stripe are colored likewise, suggesting a series of spots connected by the stripe. Venter smoky black with a whitish line across each ventral not strongly contrasted; each subcaudal smoky black with a lighter area; a blackish spot on anterior chinshields.

On No. 840 the lateral stripe is less distinct than in No. 25735. The type is said to have a yellowish collar, a character that may be confined to younger specimens.

Two specimens of the species examined at Harvard (M. C. Z. Nos. 15321 and 28070) have respectively 142 ventrals, 43 subcaudals; 141 ventrals and 34 subcaudals; supralabials 6, 6; infralabials 6, 7; the scales keeled and striate on body; there is an irregular orange stripe on sides of body in both.

Genus NINIA Baird and Girard

Ninia Baird and Girard, Catalogue of North American Reptiles in the Museum of Smithsonian Institution, Pt. 1, Serpents, 1853, p. 49.

The small ground snakes of the genus *Ninia* are numerous in Costa Rica, six forms being recognized. All the members of the genus are small and slender, rarely reaching half a meter in length.

SYNOPSIS OF COSTA RICAN FORMS OF NINIA

1. Scales in 17 rows 2
   Scales in 19-21 rows 3
2. Dorsal coloration uniform black; venter black, part of the ventrals with red marks; 6 supralabials; a sharp median keel, the body triangular in cross section; ventrals 162; subcaudals 73 ..... *psephota*
   Dorsal coloration varied, consisting of numerous blackish or brownish bands narrowing on sides, separted by narrow whitish, or brownish-white zigzag lines usually considerably less than width of one scale-length; a more or less distinct series of dark spots low on sides alternating with the larger dark bands; nuchal band approximately one scale wide, incomplete mesially; top of head dark with some small lighter flecks or dashlike marks; belly checkered with black and greenish white; a sharp keel along middorsal line; 6 supralabials (rarely 5); ventrals 158; subcaudals 68 + 1 ..... *oxynota*
3. Belly checkered with black and yellow (white or greenish white) 5
   Belly never checkered with black and yellow 4
4. Above uniform black with a yellow collar; belly immaculate or with some scattered pigment; ventrals 129-151; caudals 34-67; supralabials 7-8 ..... *atrata*

Not uniform black above; reddish or reddish brown above with black cross bars (rarely lacking); a yellow collar followed by a black one; ventrals 131-147; subcaudals 36-70; supralabials and infralabials 7 ..... *sebae sebae*

5. Brown above on body with a series of about 25 (or less) zigzag transverse black bands, sometimes light-edged, or posteriorly broken medially and alternating, becoming smaller toward, and on tail; belly checkered, the dark marks tending to form a single median, or two outer bands, or the marks may be scattered.... *maculata*
Brownish with a broken series of fifty or more narrow, dark zigzag transverse marks usually broken anteriorly, usually fused on most of body; lower scale rows may have much black pigment appearing as black flecks; upper labials with rounding white spots; neck colored like body; belly checkered irregularly with black and greenish white; sometimes a small subocular present ..... *tessellata*

Ninia sebae sebae (Duméril, Bibron and Duméril)

Streptophorus sebae Duméril, Bibron and Duméril, Erpétologie Générale, vol. 7, pt. 1, 1854, pp. 515-517 (type locality, México).

Ninia sebae Dunn, Proc. Nat. Acad. Sci., vol. 21, 1935, pp. 10-11 (Costa Rica and numerous other localities).

Ninia sebae sebae Smith and Taylor, Bull. U. S. Nat. Mus. no. 187, 1945, p. 100.

I have seen no specimens of this species from Costa Rica. It is reported by Dunn, *loc. cit.*, from "upper Costa Rica."

The color is red or reddish above usually with black cross-bands, which tend to break mesially, and may alternate on the posterior part of the body. Towards the tail the bands may be reduced to small dots. There are usually 25 (or less) present or indicated on the body. There is a strongly-defined black collar preceded by a yellow band. The venter is immaculate or with some scattered pigment not, or only rarely, forming small spots, never checkered like *maculatus*.

See synopsis of the genus for diagnostic scale characters.

Ninia atrata (Hallowell)

Coluber atratus Hallowell, Proc. Acad. Nat. Sci. Philadelphia, 1854, p. 245 (Colombia [Venezuela] less than 200 mi. from Caracas).

Ninia atrata Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1875, p. 145 (San José, Costa Rica); Dunn, Proc. Nat. Acad. Sci., vol. 21, 1935, p. 11; Dunn and Bailey, Bull. Mus. Comp. Zool., vol. 86, no. 1, 1939, p. 7.

?*Streptophorus atrata* Boulenger, Catalogue of the Snakes in the British Museum (Natural History), vol. 1, 1893, pp. 293-295 (Cartago, Costa Rica).

See synopsis of the genus for a diagnosis of this form.

The Cartago specimens reported by Boulenger have 142 ventrals and 62 subcaudals in the male; 141, 155, 140 ventrals, and subcaudals 50, 53, 52 in three females. Dunn lists two specimens from Cariblanco and Cope reports the species from San José. I have seen two specimens in the U. S. National Museum from San José, Costa Rica (Nos. 38147-48). Both are typical in color.

Two specimens in Harvard M. C. Z. (Nos. 15292-93 from Cariblanco) have the ventral-subcaudal counts respectively, 130-34 and 126-44. The light color is five scales wide and includes the

posterior parts of the parietals, some pigment being present; supralabials 8, with small black spots at the back of each scale. The belly is completely immaculate except where the dorsal coloring edges onto the ventrals; mental and first infralabials with some black markings.

Ninia maculata (Peters)

Plate V, figs. 1-3

Streptophorus maculata Peters, Monatsb. Akad. Wiss. Berlin, 1861, p. 924 (type locality, Costa Rica); Bocourt, Etudes sur les reptiles; Mission Scientifique au Mexique at dans l'Amérique Centrale, livr. 9, 1883, p. 584, pl. 33, fig. 3.

A series of specimens (M. N. H. Nos. 25690-98) was obtained at Cervantes, a village situated between Turrialba and Cartago at the site of an old lava flow from Volcán Irazú. The small snakes were ensconsed under lava rocks.

The series shows a certain uniformity of color and markings, the color being brighter and the pattern more distinct in younger specimens. The ground color is reddish brown in younger specimens with small narrow cross bands usually some of which are broken and may tend to alternate on the two sides; towards the posterior part of the body the marks become less distinct, often represented by only small blackish lateral dots. Older specimens have more dark pigment scattered in the brown so that the dark markings are less distinct. The ventral surface is light with a single median series of quadrangular (rarely triangular) black spots, or two series, one on each side; or the spots may be irregularly scattered. See plate no. V. On the first scale row, very small black spots are present at irregular intervals, each smaller than a single scale. The underside of the tail is black.

There is a well-defined black nuchal band usually about as long as three scale-lengths; a band colored like the body is in front of this, three scale-lengths long but on the sides of the head it runs forward to the eye covering the outer edges of the parietals. The dorsal surface of the head is blackish or blackish brown, with occasionally a distinct black spot on the posterior tips of the parietals.

The following scale characters obtain: the part of rostral visible above forming a broad triangle, its length less than that of internasals; latter less than one third area of prefrontals; frontal shield-shaped usually distinctly hexagonal, as broad as long, its length equal to its distance from the tip of the snout; parietal large, its length equal to its distance from tip of snout; nasal not completely divided; loreal elongate, nearly twice as long as high; no preocular;

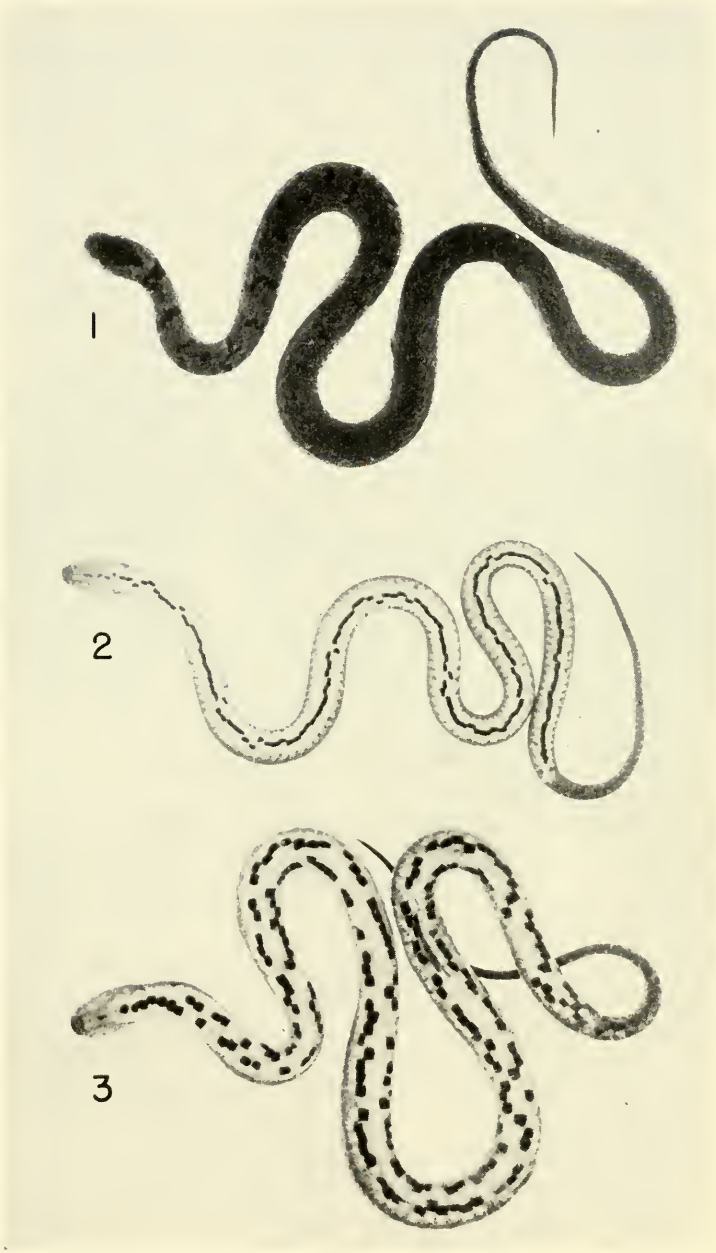


PLATE V. Fig. 1. *Ninia maculata* (Peters), RCT No. 297, Cervantes, Costa Rica, July 9, 1947; total length, 307 mm.

Fig. 2. *Ninia maculata* (Peters), RCT No. 1452, Cervantes, Costa Rica, August 26, 1947; total length, 229 mm.

Fig. 3. *Ninia maculata* (Peters), RCT No. 303, Cervantes, Costa Rica, July 9, 1947; total length, 268 mm.

postoculars two; temporals 1+2+3; supralabials seven, third and fourth entering eye; infralabials seven, the first four bordering the first chinshields, of which the first pair is nearly double the length and area of second pair; no scales intervene between ventrals and second chinshields. Scales striated strongly and all rows bearing a strong medial keel. Scale formula 19-19-17(19). Ventrals in the males range from 132-138; subcaudals 52-58; ventrals in females, 138-144; subcaudals 51-58. Total counts are 189-191 for males, 192-198 for females. Males have strong series of tubercles on mental, first pair of infralabials, the first chinshields and on some of the supralabials.

One specimen, also referred to this species, was collected on the Pacific drainage slope near the western base of Cerro de la Muerte at San Isidro El General. It differs in having the neck band nearly double the width of that of the Cervantes specimens and connecting by an isthmus to the black color on the head. The ventrals of this specimen are 139; the subcaudals 53.

It is probable that *Ninia maculata* is more closely related to *Ninia sebae* than to other Costa Rican species. The heavy black quadrangular markings on the venter of *N. maculata* will readily separate the two forms.

A series of Costa Rican specimens are in the U. S. National Museum. The variation in ventral count is 137-144, the average being about 140 (six specimens counted); subcaudals 48 to 55. Three exact localities are represented: Arriba, San José and Navarro.

Three specimens from Navarro, Costa Rica in the Harvard collection (M. C. Z. Nos. 15315-15317) have the following ventral and subcaudal counts respectively: 134-57, 141-48, 140-52.

Ninia tessellata Cope

Pl. 2, figs. 3 and 4

Ninia sebae tessellata Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875), p. 145 (type locality, ? Sipurio, Costa Rica by inference).

?*Streptophorus subtessellatus* Werner, Mitt. Naturh, Mus. Jahrg. 26. 1909 (1910), pp. 215-216 (type locality, "Carriblanco" Costa Rica); ? Amaral, Mem. Inst. Butantan, vol. 4, 1929, p. 10.

Ninia maculata Dunn, part, Proc. Nat. Acad. Sci., vol. 21, 1935, p. 11 (Canal Zone, Nicaragua, Costa Rica).

Five specimens of this species were obtained at Los Diamantes (R.C.T. Nos. 1364, 1445, 1447, 1448, and M.N.H. No. 25739) Sept. 1-8, 1947. All were found under logs.

Rostral about one third wider than high, barely visible above; internasals small, their length in that of prefrontals two and one

fourth times; prefrontals distinctly longer than wide entering the orbit; frontal about one fifth longer than wide, its length a little greater than its distance from snout tip, at least four times as wide as supraoculars; parietals elongate, equal to their distance from tip of snout; scales bordering parietals behind are not, or scarcely, enlarged; nasal divided; loreal large, quadrangular, entering orbit; preoculars normally absent (in some specimens where present they are segmented from the prefrontal if above loreal, from the third labial if below the loreal); two postoculars, the upper the larger; head scales finely striated with distinct tubercles on loreals; in males two anterior supralabials, mental, first four infralabials and both pairs of chinshields with tubercles. Scales of body strongly striate, the striation occurring also on outer edges of the ventrals. The scale formula 21-19-19-19, all rows strongly keeled; first chinshields double the area and the length of second pair. Two scale rows bordering the medial row are slightly larger than the medial scales; all three median rows tend to form a continuous keel, that of the median row not, or but slightly more elevated than the other two rows.

The ventrals and subcaudals total 175 to 184, the lowest numbers being those of the two females (175-178); the males vary between 182-184. The largest specimen measures: total length 279 mm., tail 59 mm. (R.C.T. No. 1364).

Color dark brown with a large series of narrow dark marks crossing back usually continuous but sometimes broken on median line. Occasionally dark marks on opposite sides alternate; black bands rarely wider than a scale length, but they follow the scales and the line tends to zigzag from scale to scale. Venter greenish with quadrangular markings; occasionally (as in No. 1364) median series of quadrangular marks distorted and each ventral with its posterior edge dark. Subcaudals nearly black but with some traces of lighter markings; top of head dark; labials with lighter cream areas more or less pigmented.

DATA ON NINIA TESSELLATA Cope

No.	Sex	Pre-oculars	Post-oculars	Temporals	Ventrals	Sub-caudals	Supra-labials	Infra-labials
1364	♀	1–1	2–2	1 + 2	130	45	7–7	7–7
1445	♀	0–0	2–2	1 + 2	134	44	7–7*	7–7
25739	♂	0–0	2–2	1 + 2	125	57	7–7	7–7
1447	♂	1–1	2–2	1 + 2	127	53	7–7	7–7
1448	♂	2–1	2–2	1 + 3	129	55	7–7	7–7

* The 6th labial is unequally divided transversely; also a segmented part from internasal present on one side.

I have examined the following specimens: Harvard M.C.Z. Nos. 19348-49, Salamanca, Costa Rica. They are typical in having 50 or more dark spots or bands; supralabials and infralabials 7-7. The three dorsal scale rows have keels somewhat more prominent than the other rows.

Four specimens from Guápiles (Nos. 15276, 77, 80, 81) agree in detail with the described specimen in most characters. The ventral-subcaudal counts are respectively: 132-47, 129-51, 131-53, and 130-53.

Two specimens in the U. S. National Museum from Arriba, Costa Rica (Nos. 93835-36) have the ventral-subcaudal counts respectively 126-54 and 127-55. The supralabials are 7-7, the infralabials 6-6 in both.

The types (Nos. 32568-32569, U.S.N.M.) have the supralabials and infralabials both 7-7. The ventral-subcaudal counts are respectively 128-60 and 130-60.

Ninia psephota (Cope)

Catostoma psephotum Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, (1876) 1875, p. 146 ("From higher points on the Pico Blanco, chiefly in the rainy zone at from 5000 to 7000 ft.").

Ninia psephota (part.) Dunn, Proc. Nat. Acad. Sci., vol. 21, 1935, p. 12.

This species was originally described in a genus, *Catostoma,* in which Cope included two species of small snakes from Costa Rica now regarded as belonging in the genus *Geophis.* However, it seems without question to belong to the genus *Ninia.*

The type was collected by the William Gabb Expedition on the higher parts of Pico Blanco, a high mountain in southern Costa Rica, at an elevation of from 5000-7000 ft.

The characters of the species are: scales in 17 rows, all striate, and all keeled except outer, those of the median row having stronger keels than the others; tail triangular in cross section; forehead somewhat convex; internasals four-sided; frontal with convex anterior border; prefrontal and large loreal entering orbit; nasal undivided; postoculars two, no preocular; temporals 1 + 2 + 2; supralabials six, third and fourth entering orbit, the fourth directly below eye, the sixth longest; infralabials six, first pair in contact behind mental; anterior scales of chin tuberculate in males; anterior chinshields much longer than posterior; ventrals 162, anal single; subcaudals 73. Above uniform black; below black with half or less of an occasional scutum red, forming a tessellated pattern; only a few spots on the subcaudals. Total length 480 mm.; tail 128 mm.; to rictus oris 10 mm.; width of head (posterior) 8 mm.

Ninia oxynota (Werner)

Plate VI, figs. 2-3

Streptophorus oxynotus Werner, Mitt. Naturh. Mus. Hamburg, Jahrg. 26, 1909 (1910), (type locality "Carriblanco" Costa Rica).

This species, described from a pair of specimens, has been synonymized with *Ninia psephota* (Cope), but I regard this as a very doubtful arrangement. The species *psephota* has a uniform black coloration on back and sides, while the belly is black bearing numerous red marks. In *oxynotus,* the body is banded with grayish black or grayish blue, these bands separated by narrow brownish-white transverse lines less than a scale wide; the bands narrow somewhat low on the sides and a series of black spots alternate with them; the belly is tessellated in checkerboard style in black and greenish white.

That *psephota* and *oxynota* are related is suggested by the dorsal keel and the reduced number of labials.

Three specimens of this species are at hand, all taken at a point about 5 kilometers southwest of Isla Bonita at an elevation of from 6000 to 6500 ft. M. N. H. No. 25741: rostral one third wider than high, very narrowly visible above; internasals small, their length a little less than half length of the prefrontals, and about one third of their area; prefrontals about one fifth to one fourth longer than wide, entering the orbit; frontal as wide as long, equal in length to its distance from rostral, two and two-thirds times as wide as supraocular; parietals as long as their distance from the rostral; scales bordering parietals behind, enlarged; nasal divided; loreal large, nearly rectangular in shape, broadly entering eye; no preoculars (in M. N. H. No. 25740 a preocular is present on one side); two postoculars, the upper very large, the lower small, about one sixth the area of the upper; temporals 1 + 1 + 2 (No. 25740, temporals 1+2); supralabials 6-6 (in No. 25740, 7-7), the third and fourth enter the eye in both; infralabials six, the first four touch the first chinshields, which are nearly double size of second pair; diameter of eye less than distance from eye to nostril. The scales are dimly

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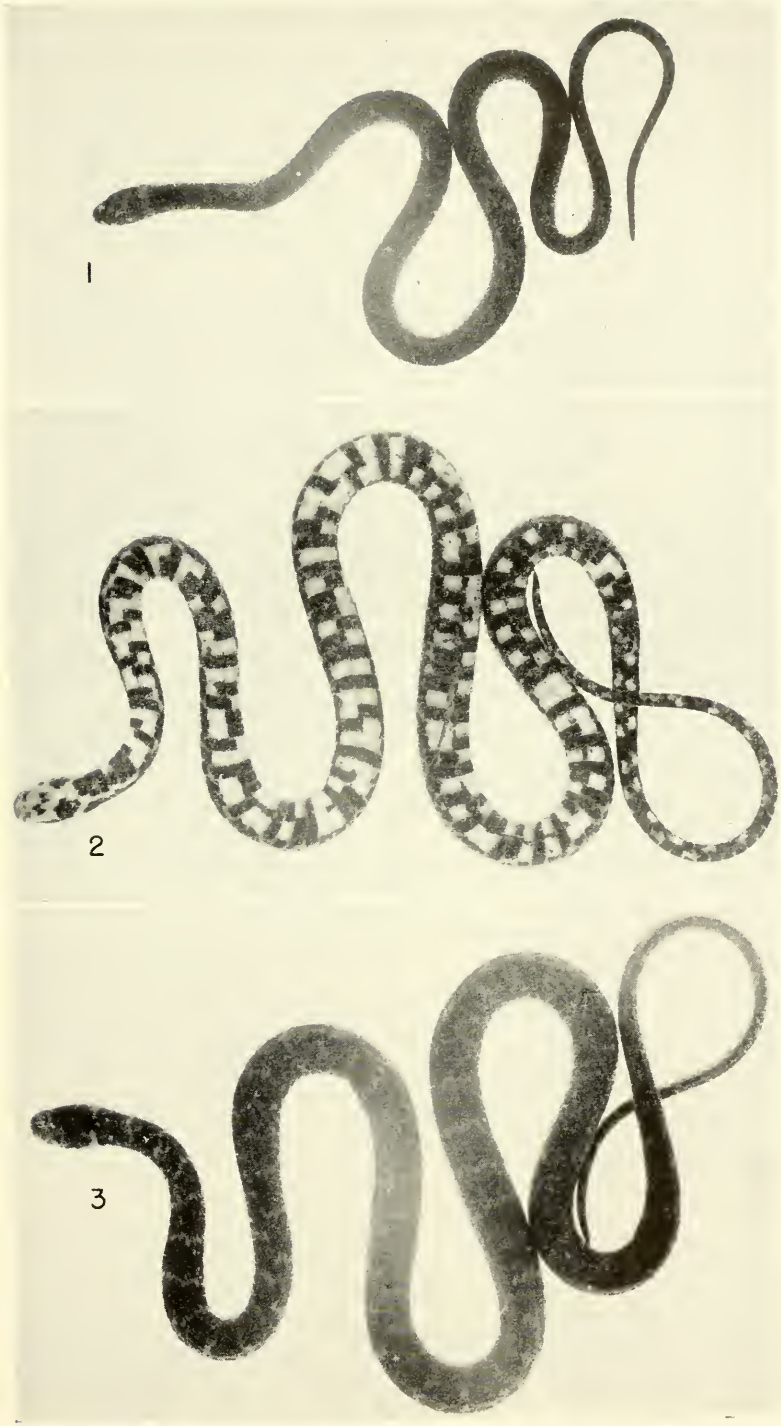
PLATE VI

FIG. 1. *Trimetopon pliolepis* Cope, RCT No. 655, 5500 feet elevation; Isla Bonita, Costa Rica; total length, 242 mm.

FIG. 2. *Ninia oxynota,* RCT No. 641, approximately 6 miles west Isla Bonita, August 3, 1947; total length, 395 mm. Ventral view.

FIG. 3. Same dorsal view.

PLATE VI



striate but distinctly keeled. Scale formula 17-17-17; ventrals 161; anal single; subcaudals, 70.

The color characters: General dorsal color brownish black with narrow transverse lighter bands of brownish varying from 54-64 in number. These indicated largely by lighter scale edges on one, or one and a half rows. Ventral surface irregularly banded with greenish cream and black. Sometimes a whole ventral scale light, or black, but more often scales parti-colored, the black being in angular spots; supra- and infralabials spotted black and greenish cream as are the chinshields. Dorsal head scales with eight brownish or cream markings.

This species has not been found outside the confines of Costa Rica. There it seems to occur only in mountains.

There are several Costa Rican specimens in Harvard M. C. Z. No. 15282 ♂, Navarro, has 157 ventrals and 76 subcaudals; No. 15283 ♂, Navarro, 152 ventrals, 73 subcaudals; No. 15313 ♀, "Costa Rica," 164 ventrals, 75 subcaudals; No. 28073 ♂, Estrella, 163 ventrals, 70 subcaudals. All of the specimens have six supralabials and six infralabials.

The following table records the chief variation in the three specimens collected:

TABLE OF DATA ON NINIA OXYNOTA

No.	Sex	Pre-oculars	Post-oculars	Temporals	Ventrals	Sub-caudals	Bands on body
641	♀	0–0	2–2	1 + 2	161	64 + 1	56 (53)
25740	♂	0–1	2–2	1 + 2	160	69 + 1	55
25741	♂	0–0	2-2	1 + 1 + 2	161	69 + 1	64

Genus DIPSAS Laurenti

Dipsas Laurenti, Specimen medicum exhibens synopsin reptilium . . . , 1768, p. 89.

Genotype: *Dipsas indica* Laurenti.

Six species occur in Costa Rica. One form described as *Dipsas ruthveni* (Barbour and Dunn) from Aguacate Mts., Costa Rica, is seemingly closely allied to *Dipsas anthracops* of Nicaragua and they may possibly be the same species. However they are here recognized as separate forms.

KEY TO COSTA RICAN SPECIES OF DIPSAS

1. Scales in 13 rows on middle of body ..... *anthracops*
   Scales in 15 rows on middle of body 2
2. Ventral-subcaudal count 300 or more 3
   Ventral-subcaudal count 290 or less 5
3. Four pairs of chinshields, the first separated from mental by first labials; 9 supralabials, fourth and fifth enter orbit; ventrals 215; subcaudals 135; yellow with

broad brown annuli, wider on anterior part of body ..... *articulata*
Three pairs of chinshields; less than 9 supralabials 4
4. Head longer; eight upper labials, fifth and sixth enter orbit; ventrals (?), subcaudals 121. Dorsal color (?), belly yellow with brown cross-bands on anterior part of body, the posterior part with alternating brown spots; throat and lips spotted brown ..... *pictiventris*
Head shorter; seven labials, the fourth, fifth and sixth border orbit; ventrals 202; subcaudals 121; first chinshields touch mental; brown cross-bands anteriorly; posteriorly with alternating spots ..... *argus*
5. Scales 15-13; part of dorsal scales at least slightly enlarged; ventrals 165, subcaudals 79. Banded brown and whitish, the anterior bands three times width of interspaces (25 body bands, 13 caudal) ..... *ruthveni*
Scales 15-15; median dorsal scale row enlarged or not; chinshields touch mental ... 6
6. Four pairs of chinshields, first small. Pale brown with dark brown rings; head brown spotted, two larger spots on parietals; ventrals 164-169, subcaudals 113-114 ..... *annulata*
Three pairs of chinshields, the first largest. Greenish with a median series of light spots; ventrals 161, subcaudals 94 ..... *costaricensis*

Dipsas anthracops (Cope)

Leptognathus anthracops Cope, Proc. Acad. Nat. Sci. Philadelphia, 1868, pp. 108, 136 (type locality, "Central America").

Tropidodipsas anthracops Boulenger, Catalogue of the Snakes in the British Museum, vol. 3, 1896, p. 297 (no specimen, Nicaragua).

Dipsas anthracops Dunn, Notulae Naturae no. 108, 1942, p. 7 ("Pacific side Costa Rica").

Twenty three yellow rings on body, twelve on tail separated by 9½ rows of scales anteriorly, and four rows posteriorly; yellow rings wider behind; these may alternate on belly, which is otherwise unspotted; no white marks on head; temporal region and nape yellow. Ventrals 177, subcaudals 76 (may be partly undivided); chinshields normal with groove between; first two pairs wider than long, third pair wider than long; temporals 1 + 2 + 3; no preocular; postoculars two; seven supralabials, eight infralabials. Scales in 13 rows, smooth; dorsals not enlarged, first labials in contact behind mentals.

This species has been reported on the Pacific side of Costa Rica by Dunn, *loc. cit.*

Dipsas pictiventris (Cope)

Leptognathus pictiventris Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875), p. 130, pl. 28, fig. 8 (type locality, E. Costa Rica); Günther, Biologia Centrali-Americana; Reptilia and Batrachia, Oct. 1894, p. 142; Boulenger, Catalogue of the Snakes in the British Museum, vol. 3, 1896, p. 459 (thought to be a synonym of *argus*); Cope, Bull. U. S. Nat. Mus. No. 32, 1887, p. 66.

S[ibynomorphus] pictiventris Barbour and Dunn, Proc. Biol. Soc. Washington, vol. 34, 1921, p. 158 (Costa Rica).

Head longer and narrower than *argus;* scales in 15 rows, smooth, the lateral scales a little smaller than dorsals, but median series not enlarged; the elongate anterior chinshields touch mental, the first infralabials not being in contact; internasals somewhat triangular, frontal wide, nasal single; a presubocular below loreal; postoculars

two; supralabials eight, fifth and sixth enter orbit; temporals 1 + 2; seven infralabials; three pairs of chinshields, first elongate, one half longer than second pair; second and third pairs short and wide.

Belly yellow with brown cross bands on the anterior part of body; the posterior part with large alternating brown spots. Back occasionally crossed by spots. Throat and lips brown spotted. Ventrals ?, subcaudals 121.

The type specimen described by Cope is defective, and the all-important number of ventrals cannot be determined; at least 161 are present but it is certain that this does not represent the total number.

Boulenger has regarded *argus* and *pictiventris* as synonyms. An examination of the types leaves me with the opinion that they are distinct. The very bad condition of the type of *pictiventris* makes it impossible to ascertain all pertinent characters.

Dipsas argus (Cope)

Leptognathus argus Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875), p. 130, pl. 27, fig. 1, pl. 28, fig. 7 (type locality, Sipurio, Costa Rica); Boulenger, Catalogue of the Snakes in the British Museum (Natural History), vol. 3, 1896, pp. 458-459.

S[ibynomorphus] argus Barbour and Dunn, Proc. Biol. Soc. Washington, vol. 34, Dec. 21, 1921, p. 158 (Costa Rica).

This is an extremely slender snake, the body compressed; head wide, the snout short; rostral triangular, as high as wide, very small, scarcely visible from above; internasals small, the prefrontals large bordering orbit; frontal with parallel sides, equal to length of anterior border; supralabials seven, the fourth, fifth and sixth border the orbit; 2 postoculars; temporals 1-2; infralabials seven, the first pair not in contact behind the mental, four touching first chinshields; three pairs of chinshields, the two anterior pairs elongate, longer than wide, the third pair quadrate, smaller; scales in 15 rows, smooth, larger above than on sides, the median row not abruptly larger than those adjoining.

Ventrals 202,* anal single, subcaudals 121.

Color above, from the third row of scales, greenish ash, with two series of alternating light ocelli with black borders; lower on side the third scale row yellow with a series of black-edged ocelli like those of the back; on venter, blackish; speckled on the posterior half of the length. A large black-bordered ocellus on the nape; head vermiculated with black; lips yellow with black specks.

* I have counted only 202 ventrals in the type; 212 as given in the type description.

Dipsas articulata Cope

Dipsas brevis (not of Duméril, Bibron and Duméril) Cope, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 266 (Cocuyas de Veraguas, New Granada).

Leptognathus articulata Cope, Proc. Acad. Nat. Sci. Philadelphia, 1868, pp. 107, 135 (Veraguas, Costa Rica [this may be in error]).

S[ibynomorphus] articulata Barbour and Dunn, Proc. Biol. Soc. Washington, vol. 34, Dec. 21, 1921, p. 158 (Costa Rica).

Body slender, strongly compressed, vertebral scales moderately enlarged. Loreal and prefrontal border eye; no preocular; two postoculars; temporals 2 + 3; nine supralabials, the fourth and fifth enter orbit; first pair of infralabials in contact behind mental; four pairs of chinshields. Scales in 15 rows; ventrals 215; anal single; subcaudals 135. Yellow with broad brown annuli surrounding body, wider on anterior part of body than on posterior, and wider than the interspaces of yellow; top and sides of head, supralabials in front of eye, and all infralabials brown; some short, white or yellow lines on head. Total length about 675 mm.; tail 225 mm.

I have not examined a Costa Rican specimen. It is retained in the list because of the report of Barbour and Dunn, *op. cit.*

Dipsas annulata (Günther)

Leptognathus annulatus Günther, Ann. Mag. Nat. Hist., ser. 4, vol. 9, 1872, p. 30 (type locality, Cartago, Costa Rica); Biologia Centrali-Americana; Reptiles and Batrachians, 1895, p. 141, pl. 49, fig. C.

Leptognathus annulata Boulenger, Catalogue of the Snakes in the British Museum, vol. 3, 1896, p. 457.

S[ibynomorphus] annulata, Barbour and Dunn, Proc. Biol. Soc. Washington, vol. 34, Dec. 21, 1921, p. 158 (Costa Rica).

A female specimen (No. 25702) was captured at Isla Bonita (American Cinchona Plantation) by Sr. Antonio Machado, Aug. 5, 1947, and presented to the collection.

Body distinctly compressed with broad thick head and large, protuberant eyes. Rostral not or scarcely visible from above, as high as wide; internasals subtriangular, about one third the length of prefrontals; latter very large, much wider than long, bending down on side and forming a part of orbit boundary; frontal much longer than wide, pentagonal, and about one sixth longer than its distance from tip of snout; parietals large (3.5 x 5 mm.), shorter than their distance from snout tip; supraoculars rather narrow, more or less angular behind, bending down somewhat behind eye; nasal single, pierced by the nostril, from which a small suture emerges terminating on the upper border; loreal, which replaces the preocular, longer than high; 2 postoculars; temporals 1+2+2; supralabials 7-7, increasing in size to sixth, the fourth and fifth entering orbit; infralabials 7-9; a small pair of scales inserted between the mental

and first very large pair of chinshields, each in contact with two labials; chinshields touch 4-5 infralabials, the last being very large; second pair of chinshields in contact, little more than half size of first pair; a third pair of chinshields in contact, somewhat larger than second pair, precedes first ventral; ventrals 169; anal single; subcaudals 113. Scale formula, 15-15-15, the scales all smooth apparently without trace of pits. The median scale row much enlarged.

Total length, 501 mm.; snout to vent, 330 mm.; tail, 171 mm.; width of head, 8.6 mm.; head length, 12.6 mm.

Banded red brown and raspberry pink, the brown bands becoming darker low on sides, and black below, the pink bands becoming white below; 27 red-brown bands on body, 18 on tail; these are two or three scales wide on median line, being a little broader on tail; on venter bands narrow and usually the width of two ventrals, while the white may occupy parts of three or four ventrals. Head brownish with an indefinite lighter pattern; the temporal areas being, on the whole, lighter than remainder. A distinct cream spot on fourth supralabial and a cream spot covering parts of fifth and sixth; infralabials and chin cream, with numerous brownish blotches.

Compared with the type description, the differences are indeed small. The type has a small subocular below the loreal that is wanting in this specimen. The type has 164 ventrals, and 113 subcaudals while this specimen has 169 ventrals and the same number of subcaudals. The specimen is somewhat larger, 501 mm. total length, compared to 440 mm., the length of the type.

Dipsas ruthveni (Barbour and Dunn)

Sibynomorphus ruthveni Barbour and Dunn, Proc. Biol. Soc. Washington, vol. 34, 1921, p. 158 (type locality, Aguacate Mts., Costa Rica); Werner, Zool. Jahrb., 1929, p. 189 (no specimens).

This form is close to *Dipsas anthracops* and it may be necessary to reduce it to the synonymy of that species.

Body strongly compressed anteriorly, less compressed along midbody region; tail diminishing suddenly in diameter behind vent; strongly compressed posteriorly; rostral pentagonal scarcely visible above; prefrontal large, broadly entering orbit; frontal longer than wide, about equal to its distance from tip of snout; nasal partially divided; loreal twice as long as high, entering orbit; no preocular; two postoculars; temporals 1+2; seven or eight supralabials, fourth and fifth enter orbit; first lower labials in contact behind mental; a pair of elongate chinshields; scales in 15 or 13 rows without apical

pits; the scale rows bordering the median row may be slightly enlarged.* Ventrals 165, subcaudals 79.

Banded brown and whitish; the brown bands anteriorly thrice as wide as the light bands, posteriorly nearly equal and of solid color; white bands clouded by groups of small darker streaks and flecks; bands diagonal, tending to alternate on belly; 25 bands on head and body; 13 on tail. Total length 425 mm.; tail 110 mm.

Dipsas costaricensis sp. nov.

Plate VII, text fig. 2

Type.—Mus. Nat. Hist. Univ. Kansas No. 25703, collected five miles southwest of Turrialba, on the Morehead finca, July 16, 1947; E. H. Taylor, collector.

Diagnosis.—Body moderately compressed, not noticeably slender; first labials not in contact behind mental; no preocular, median scale row not sensibly enlarged; ventrals 161, subcaudals 94. Lichen-green with a median series of light spots and with lateral and ventral ocellilike spots.

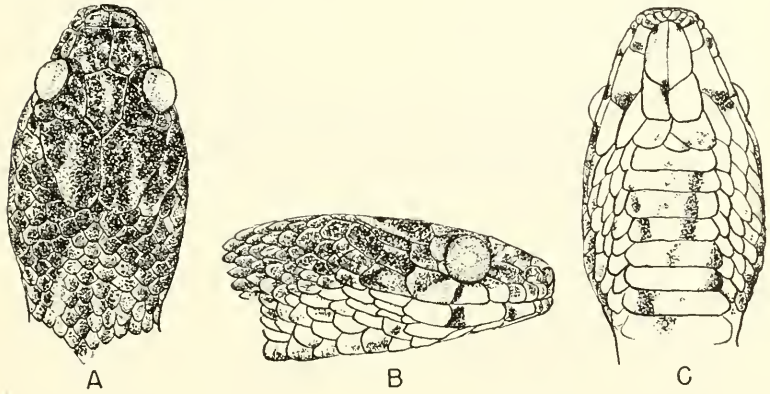


FIG. 2. *Dipsas costaricensis sp. nov.* Type. MNH No.25703. Morehead Finca, 4½ miles SW Turrialba, Costa Rica. A. Head dorsal view; B. Head lateral view; C. Head ventral view.

Description of the type.—Body more or less compressed, triangular in cross section, the head not much enlarged; eyes small; rostral small, not or scarcely visible from above, slightly broader than high; internasals small, a little less than one third length of the prefrontals, and about one fifth of their area; latter very large, a little

* The original description states "scales in 15 rows without apical pits, median row not sensibly enlarged or 13 rows with rows on each side of the median row slightly enlarged." This is not clear but since there was but a single specimen, both conditions must obtain in the same specimen.

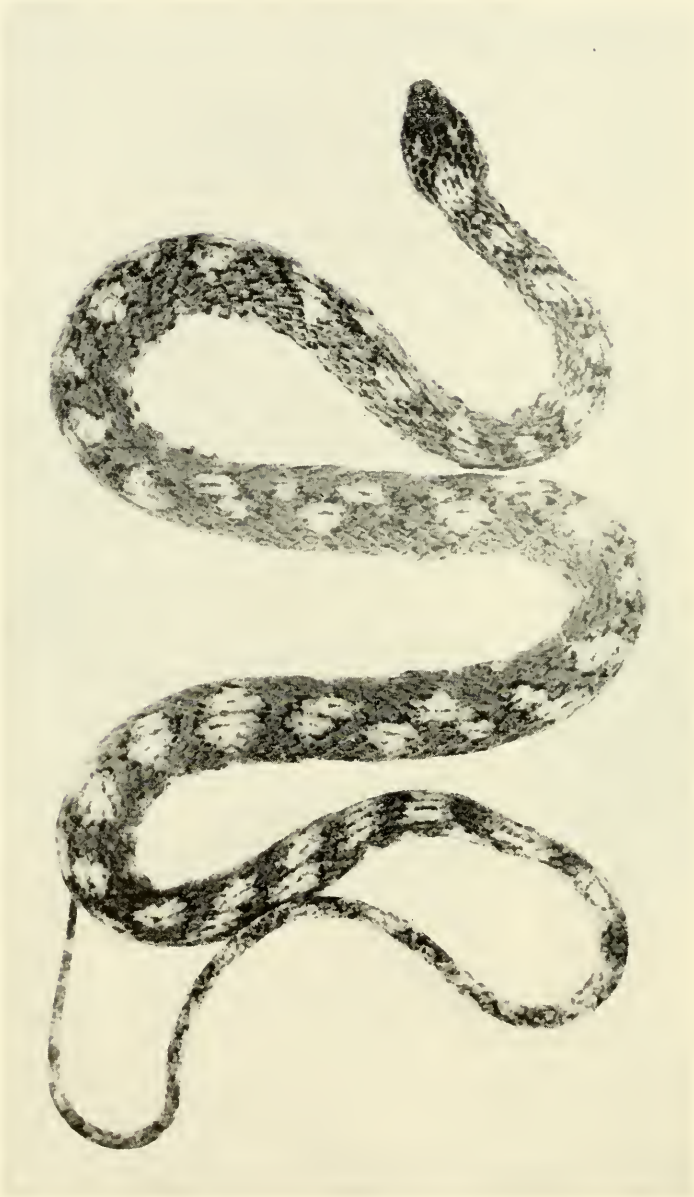


PLATE VII. *Dipsas costaricensis* sp. nov., MNH No. 25703, Morehead Finca, 5 miles SW Turrialba, Costa Rica. Total length, 47 mm.

broader than long, entering orbit for a distance equal to that of the loreal; frontal about one sixth longer than its distance from tip of snout, about one third longer than wide; parietals large (3.24 x 5 mm.) shorter than their distance from tip of snout; supraocular curving slightly, widest but not angular, posteriorly; nasal partially divided by a suture from nostril to upper edge of scale; loreal nearly twice as long as high, entering orbit; no preocular; 2-1 postoculars, the upper very large (the two fused on left side); temporals, 1+2+2 (2+2+2); supralabials, 7-6, the fourth, fifth and sixth (fourth and fifth) entering orbit; infralabials 6-6, four touching first pair of chinshields which are in contact with mental; second pair of chinshields in contact with each other, smaller than first pair; third pair in contact, irregularly shaped.

Scales smooth, without apical pits, the median dorsal row not enlarged; scale formula: 15-15-15; ventrals 161; subcaudals 94; anal single.

Color in life.—Lichen-green, the color interrupted on the scale edges by a variegated brown or black; a dorsal series of 33 brownish yellow blotches, variegated with dark brown and dusky markings on body; on tail there are 15-16 but these are rather indefinite; low on the sides and encroaching on the ventrals is a series of cream-white, dark edged, ocellilike markings; chin whitish with a faint yellow wash; neck and anterior fourth of body nearly pure white with small greenish or black flecks forming an irregular, indistinct, median line; there is more yellow color on latter three fourths of body; there are similar dark markings becoming more dense under tail with some greenish and yellow flecks. On dorsal surface the head is nearly uniform black-brown with some indistinct reddish brown marks; a divided white blotch below eye; chin with a distinct pair of black spots on the fourth labials and a few other less distinct flecks of greenish black.

Measurements.—Total length, 477 mm.; tail, 147 mm.; width of head, 9 mm.; length of head, 13.5 mm.; diameter of body, 10 mm.

Remarks.—This form differs from *argus* in having a much smaller ventral-subcaudal count (255 compared to 323 in *argus*); from *pictiventris* in a much lower number of subcaudals (94 compared to 121 in *pictiventris*) and a thicker body; from *articulata* in having mental touching chinshields and much lower ventral-subcaudal count (255 compared to 350 in *articulata*); from *annulata* in having the mental separated from the first chinshields, smaller ventral-

subcaudal count (255 compared to 277), and the median dorsal scale row not enlarged; from *ruthveni* by having the scale rows constantly 15, not reducing to 13, and a different color pattern.

Genus NEOPARIAS Günther

Neoparias Günther, Biologia Centrali-Americana; Reptilia and Batrachia, July, 1895, p. 178.

Genotype: *Neoparias bicolor* Günther.

A single Costa Rican species is referred to this genus.

This genus has quite incorrectly been associated with *Leptognathus* (*Sibynomorphus* or *Dipsas*); the striking character of the chinshields in *Neoparias* readily separate the two genera.

Neoparias bicolor Günther

Neoparias bicolor Günther, Biologia Centrali-Americana; Reptilia and Batrachia, July 1895, pp. 178-179, pl. 56, fig. C (type locality, Chontales Mines, Nicaragua).

Leptognathus bicolor Boulenger, Catalogue of the Snakes of the British Museum, vol. 3, 1896, p. 460.

S[ibynomorphus] bicolor Barbour and Dunn, Proc. Biol. Soc. Washington, vol. 34, 1921, p. 158 (Costa Rica).

Body slender, strongly compressed; tail slender; scales of the vertebral series not enlarged; scales on chin transverse, lacking a median groove; rostral small, scarcely visible above; internasals less than half size of prefrontals; frontal short, wide, about equal to its distance to rostral, only a little shorter than parietals; nasal apparently completely divided; a large square loreal entering eye, and a small preocular above it not reaching frontal; three or four postoculars; temporals $1 + 2 + 3 + 3$; supralabials 10-11, the fourth to seventh, or the third to sixth enter orbit; infralabials 11, the first pair fused together behind the small mental; three median azygos scales on chin, the first touching five scales; scales smooth, in 15 rows; ventrals 195; subcaudals 129.

Deep black with white rings completely encircling the body, the first around the neck, 14 around the trunk, 12 around the tail; the white rings half as long as the black interspaces; length about 516 mm.; tail about 192 mm. (from type description).

The species is arboreal, and perhaps because of this habit is very rare in collections.

Genus TRETANORHINUS Duméril, Bibron and Duméril

Tretanorhinus Duméril, Bibron and Duméril, Erpétologie Générale ou Histoire Naturelle Complète des Reptiles, vol. 7, pt. 1, 1854, pp. 348-349.

Genotype: *Tretanorhinus variabilis* Duméril, Bibron and Duméril.

Only a single species of this genus is believed to occur in Costa Rica.

Tretanorhinus nigroluteus nigroluteus Cope

Tretanorhinus nigroluteus Cope, Proc. Acad. Nat. Sci. Philadelphia, 1861, p. 298 (type locality, Aspinwall, Panamá [*fide* Dunn]).
Tretanorhinus nigroluteus nigroluteus Dunn, Copeia, 1939, no. 4, p. 216.

The presence of this species in Nicaragua and Panamá strongly suggests its presence likewise in Costa Rica, although I know of no Costa Rican specimens that have been reported.

The species has the following characteristics: blackish or olive brown on dorsum, usually with small alternating dots on each side, the dots variable in size, usually covering about one scale; two lower scale rows lighter in color tending to form a stripe anteriorly; venter light yellowish or whitish, sometimes with dots or a suggestion of a midventral darker line; a dark streak on sides of head.

Nasals in contact behind rostral or narrowly separated; internasals distinct, small, longer than wide; frontal as long as its distance from end of snout, shorter than parietals; eight supralabials, the fourth entering the orbit; normally two preoculars, two postoculars and usually two loreals; ventrals of southern specimens 133-149; the subcaudals 56-80; scales in 21 rows.

This form is aquatic and is said to frequent salt water, mangrove swamps.

Genus SIBON Fitzinger

Sibon Fitzinger, Neue Classification der Reptilien, 1826, p. 31.

Genotype: *Coluber nebulatus* Linnaeus.

A single species is known.

Sibon nebulatus Linnaeus

Coluber nebulatus Linnaeus, Systema naturae, ed 10, vol. 1, 1758, p. 222 (type locality, "Africa [presumably in error]).
Coluber sibon Linnaeus, Systema naturae, ed. 10, vol. 1, 1758, p. 222.
Sibon nebulatus Taylor, Univ. Kansas Sci. Bull., vol. 26, 1939 (1940), pp. 473-474.
?*Sibon annulata* Dunn and Bailey, Bull. Mus. Comp. Zool., Harvard Coll., vol. 86, 1939, p. 9 (Costa Rica).
Leptognathus nebulata Cope, Journ. Acad. Nat. Sci. Philadelphia, 1876 (1875) p. 131 (southeastern Costa Rica).

This very widespread species is not common in collections and is relatively little known. The following characters will permit a diagnosis: maxillary short, with 15-16 short teeth decreasing in size posteriorly; rostral visible above as a narrow line, not reaching level of dorsal surface of head; internasals and prefrontals normal, the latter entering orbit; frontal pentagonal, as long as (or a little longer than) its distance from tip of snout; parietals a little longer than wide, their length less than, or approximately equal to their dis-

tance from prefrontals; nasal completely divided; loreal large, rectangular, entering orbit; no preocular; postoculars two or three; temporals 1 + 2; supralabials seven, the fourth and fifth or fourth, fifth and sixth entering orbit; five or six infralabials touch anterior chinshields, which are longer than second pair; a third pair of chinshields may be present, the scales of which are wider than long.

Scale rows 15-15-15, or the preanal count may reduce to 13; scales smooth without pits. Ventrals 170-197; subcaudals 73-102; anal single; probably not exceeding a meter in length; known length, 790 mm.; head large and distinct from neck; eye large, the pupil vertically elliptic, the body somewhat compressed.

Gray or whitish above marked with numerous irregular transverse black or brown markings which may extend across body or may be broken into two or three parts, the edges of which are very irregular; some scales bordering spots may be pure white; a nuchal dark spot bordered by white dots; head marked with dark spots; a dark line from eye to jaw; upper labials whitish; chin and lower surfaces white with a series of more or less alternating quadrangular dark spots on the sides of the venter with small flecks scattered between.

Two specimens in the U. S. National Museum numbered 30621, 30622 are a part of the early collection made by William Gabb. They agree in most characters with the given description. No. 30621 has 185 ventrals and 99 subcaudals, the anal single. There are approximately 40 bands. The head is brown with numerous white flecks, which tend to form a symmetrical pattern. No. 30622 has 171 ventrals and 85 subcaudals. There are 41 bands. The maxillary teeth are 14, slender, curved, none grooved. The posterior part of the maxillary forms an elevated ridge.

It is presumed that the two listed specimens were taken in southeastern Costa Rica, where much of the William Gabb Collection was made.

The species has been reported also from Guápiles in the eastern lowlands.

Genus XENODON Boie

Xenodon Boie, Isis, 1827, p. 540.

Genotype: *Xenodon inornatus* Boie (*fide* Fitzinger).

Two forms are known to occur in Costa Rica.

KEY TO COSTA RICAN SPECIES OF XENODON

Body marked with large paired lateral spots, discrete anteriorly, often touching posteriorly ..... *bertholdi*

Body marked with large irregular saddlelike blotches..... *colubrinus*

Xenodon bertholdi Jan

Xenodon Bertholdi Jan, Arch. per la Zool., 1863, pp. 318-319 (same in separate, pp. 108, 109) (type locality said to be "Mexico." Very doubtful).

The type description of this species gives the following characters: one preocular, three postoculars; temporals 1+2; supralabials eight; ten infralabials, six touching the chinshields; 19 scale rows and 13 rows behind anus; ventrals 153, anal single; subcaudals 42. On each side of the trunk is a series of large oval spots separated from each other mesially.

The color pattern of a snake captured at Turrialba (K. U. No. 25167) closely approaches the color characters of the type of *X. bertholdi*. In this specimen the spots are outlined in black, and bordered by light ash-gray; six of the fourteen spots are separated on the middorsal line, the others being narrowly in contact.

In this specimen a pair of gray lines, spotted and flecked with black, passes back from the eye to a point on the neck across jaw angle. The area between these lines is rather brownish fawn. A character that may be of significance is that the supraoculars are not truncate on their posterior border, but extend a noticeable distance behind the posterior end of the frontal. A pair of black spots are present on the prefrontals. The labials are brownish fawn and the chin and neck as far back as fifth ventral are white. The anal scale is white. The venter is covered with flecks of pigment, scattered irregularly. The subcaudal area has a peppering of black at the base, but is nearly cream-white near the tip.

A specimen (M. C. Z. No. 19238) from Limón, Costa Rica has a paired series of large spots on the anterior half of body, while between them are small dark medial spots. Paired spots on posterior part of body fused mesially. Ventrals 145; subcaudals 44; scales, 19-19-17 with single apical pits on dorsal scales; supralabials 8-8; infralabials 10-11, five (or six) touching first chinshields which are twice size of second pair.

A specimen in the U. S. National Museum, No. 37482 (or 3) from Esparta, Costa Rica, has 150½ ventrals and 46+ subcaudals.

If the type of this species actually is Mexican, it bespeaks a wide range for the form.

Xenodon colubrinus Günther

Xenodon colubrinus Günther, Catalogue of Colubrine Snakes in the Collection of the British Museum, 1858, pp. 55-56 (type locality, Pará, Brazil).

The type of *Xenodon colubrinus* has the following scale characters: scales smooth in 19 rows; one preocular, two postoculars; two nasals, the nostril very large; anal single; 151 ventrals, 45 subcaudals;

14 lozenge-shaped, pale-edged blotches on the trunk, four on tail. Head elongate, snout protruding, angular in front. Rostral just visible above; frontal about as long as wide; parietals short; loreal large, nearly square; eight supralabials, the fourth and fifth touch eye. Head dusky; a brown marbled streak from the back edge of eye to mouth angle; belly yellowish brown marbled.

The following additional characters obtain: rostral one and one-third times as wide as high; frontal as long as wide, the length reaching to middle of internasals; parietals a little wider than long, their length equal to that of frontal; supraoculars truncate behind, not extending back beyond level of frontal; first chinshields one and one-half times size of second pair which are nearly separated by the scales following. The scales on sides form diagonal series.

The two Costa Rican specimens acquired by gift from Mr. Virgil Cave agree in general with the characteristics of the type. It is difficult to state the variational limits of this species since no recent revisional work has been done on the genus, and the name as now understood is probably composite.

TABLE OF DATA FOR XENODON COLUBRINUS GÜNTHER

No.	Sex	Ventrals	Subcaudals	Supralabials	Infralabials	Labials enter orbit	Labials contact chinshields
851	♀	151	45	9–9	11–11	4^{th} 5^{th} 5^{th} 6^{th}	5–5
1001	♂	144	..	8–8	11–11	4^{th} 5^{th}	5–5

TABLE OF DATA FOR XENODON COLUBRINUS GÜNTHER (concluded)

No.	Scale formula	Anal	Preocular	Postocular	Temporals	Bands on body	Teeth
851	17–19–17	1	1–1	2–1	1 + 2	13	14 + 2
1001	17–19–17	1	1–1	3–1	1 + 2	13	13 + 2

Genus ENULIUS Cope

Enulius Cope, Proc. Amer. Philos. Soc., vol. 11, 1871, p. 559.

Genotype: *Enulius murinus* Cope = *Enulius flavitorques* Cope.
One species is known in Costa Rica.

Enulius flavitorques Cope

Liophis flavitorques Cope, Proc. Acad. Nat. Sci. Philadelphia, 1868 (1869), p. 307 (type locality, Magdalina River, Colombia).

Drepanodon ? flavitorques Boulenger, Catalogue of the Snakes in the British Museum, vol. 3, 1896, p. 639 (no specimens).

Enulius flavitorques Dunn, Proc. Acad. Nat. Sci. Philadelphia, vol. 89, 1937 (1938), pp. 415-417 (Costa Rican records Marivalles, Barranca and Cartago).

I have seen no specimen of this form from Costa Rica. The salient characters are as follows:

Rostral projecting and well visible above; frontal very broad, with a long-produced posterior angle; internasals about as long as wide; prefrontals considerably wider than long; nasals higher than long, narrower than loreal; preocular higher than long; loreal higher than long, the suture straight above, angulate below; postoculars two; temporals 1 + 2; supralabials seven, all higher than long except last; third and fourth enter orbit; infralabials seven, fourth elongate, first pair in contact behind the mental; posterior chinshields half as long as anterior, separated by a scale; scales in 17 rows. Ventrals 188; anal divided; subcaudals 105. Total length about 420 mm.; tail about 132 mm. Uniform dark brown above with a broad yellow half-collar crossing the posterior part of the parietal shields and two transverse rows of scales; venter dirty yellow.

There is some doubt that the form *Enulius murinus* Bocourt [= *Enulius longicaudata* (Cope)] is a synonym of this species. It is not impossible that the latter is the proper name for the Costa Rican species, but the matter cannot be decided now.

This species is reported as having single apical pits on the scales. It may readily be separated from *Enulius sclateri,* which has four (two pairs) apical pits on the dorsal scales.

I have examined casually a series of specimens of this species from Honduras and Panamá. There is considerable difference in the head marking and nuchal band. Its presence in Costa Rica is attested by Dunn's records, *loc. cit.*, from Marivalles, Barranca and Cartago.

Enulius sclateri (Boulenger)

Plate VIII, text fig. 3

Leptocalamus sclateri Boulenger, Catalogue of the Snakes in the British Museum, ed. 2, vol. 2, 1894, p. 251, pl. xii, fig. 1 (type locality, "South America"); vol. 3, 1896, p. 641 (Guásima, Costa Rica).

Enulius slateri (*sic*) Dunn, Proc. Acad. Nat. Sci. Philadelphia, vol. 89, 1937 (1938), p. 417; Smith and Taylor, U. S. Nat. Mus. Bull. no. 187, 1945, p. 61.

This species is known in literature from the type description, and from some brief notes given by Dunn, *loc. cit.* The specimen here described was captured at Los Diamantes (near Gúapiles, Costa Rica) by Richard C. Taylor. It was discovered by chopping to pieces a rotting log in which the snake was concealed. The following characters obtain:

Rostral at least twice as broad as high, its border along internasals almost straight rather than angular, the length of part visible above a little more than half length of internasals; suture between internasals equal or larger than that between prefrontals, but the scales much shorter than prefrontals which enter eye; frontal much longer

than broad, four-sided, its length one and one-half times greater than its distance from tip of snout; parietals elongate, a little longer than the frontal; supraocular reduced, but extending above more than half of the eye; nasal divided, anterior part the larger, containing most of nostril; loreal elongate forming part of border of eye; two postoculars, the upper somewhat the larger; temporals, 1 + 2, the anterior rectangular, touching both postoculars; seven supralabials in following order of size: 1, 2, 5, 4, 3, 7, 6, (1, 2, 4, 5, 3, 7, 6), third and fourth entering orbit; six lower labials in following order of size: 2, 1, 5, 4, 3, 6, first labials in contact behind mental; first chinshields in contact anteriorly, separated posteriorly by a median diamond-shaped scale; second pair of chinshields widely separated; two scale rows separate first ventrals from labials.

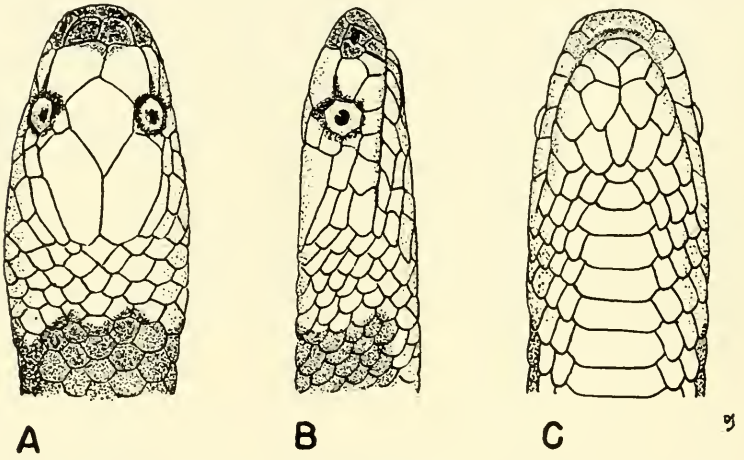


FIG. 3. *Enulius sclateri*. R.C.T. No. 1368. Collected, Los Diamantes, near Guápiles, Costa Rica. A, Head, dorsal view; B, Head, lateral view; C, Head, ventral view. ×4.

Scale formula, 19-15-15-15; scales smooth, the anterior 20 transverse scale rows each with four scale pits, two anterior, two posterior, the latter appearing slightly the smaller; no pits apparent on other scales; ventrals 145; anal divided; caudals 96 + 1.

Above blue-black, the scales on sides showing slightly lighter edges· chin, throat and venter as far as anal opening, white, the lateral color not extending onto the edges of ventrals; usually a whitish area on the scales of the outer row; caudals with a median dark line beginning behind vent; the color of outer scale rows encroaches somewhat on edges of subcaudals so that they appear grayish with some dim lighter areas. The head is pure white with a dark ring

surrounding the eye and a black spot covering first labial, rostral, internasals, nasals, and a small triangular area on the prefrontals.

The measurements (in mm.) are as follows: width of head, 6; length of head, 10.2; total length, 345; tail, 135.

The specimen is a male and it agrees with the type specimen in most characters. The known ventral range is 132-151; subcaudals 97-98.

PLATE VIII. *Enulius sclateri* (Boulenger), RCT No. 1368, Los Diamantes, Costa Rica, September 6, 1949; total length, 345 mm.

I have examined two Harvard specimens, M. C. Z. Nos. 28079-80, from Peralta, Costa Rica. These agree with the described specimens.* Specimens are known from Gúasimo and Finca Hamburg.

Genus HELICOPS Wagler

Helicops Wagler, Natürliches System der Amphibien, 1830, p. 170 (*part.*)

Genotype: Helicops angulatus Linnaeus.

A single species has been reported from Costa Rica.

Helicops wettsteini Amaral

Helicops wettsteini Amaral, Bull. Antiv. Inst. Amer., vol. 3, no. 2, p. 40 (San Juan de Viñas [1000 m. alt.] base of Volcán Turrialba, central Costa Rica).

This species may be readily recognized by the contact of the nasal scales behind rostral.

Eye small; rostral wider than high, visible from above; nasals in contact behind rostral; internasal single; prefrontals separate; frontal once and two-thirds times as wide as long, as long as its distance from the end of snout, shorter than the parietals; loreal higher than long; one preocular, two postoculars; temporals 1 + 2; supralabials eight (8-9 in paratype), the fourth and fifth border orbit; anterior chinshields longer than posterior, touching five or six lower labials; scales in 19 rows, smooth; ventrals 128; anal divided, subcaudals 37-38. Total length, 375 mm., tail 50 mm.

The color is uniform dark plumbeous above; light underneath with a median interrupted black streak and a blackish line along outside border of ventrals.

The species is known from the two types, collected at Juan Viñas (San Juan de Viñas, 1000 m. elev.).

Genus HYDROMORPHUS Peters

Hydromorphus Peters, Monatsb. Akad. Wiss. Berlin, 1859, p. 276.

Genotype: *Hydromorphus concolor* Peters.

A single species is known from Costa Rica.

Hydromorphus concolor Peters

Hydromorphus concolor Peters, Monatbs. Akad. Wiss. Berlin, 1859, pp. 276-277 (type locality, Costa Rica).

This medium-large snake still remains rare in collections. The uniform color, smooth scales, small eye, single prefrontal, and the nostril directed upward piercing a single scale, readily identify the

* A specimen, Harvard M. C. Z. No. 34382 (Canal Zone, Atlantic Side), differs in having the rostral, prefrontals, internasal, anterior part of frontal, and area about eye, black except that the nostrils are whitish; second, third and fourth labials white except about eye; two small black areas on lower lips; the neck ring includes the back of head and four transverse scale rows.

species. The following characters are those of the type.

Head depressed, with broadly rounded snout; nasals separated by a pair of very small internasals; prefrontals much broader than long; frontal slightly longer than broad, as long as its distance from the rostral, much shorter than parietals; loreal entering orbit, twice as long as high; one small preocular; two postoculars; temporals 1 + 2; six supralabials, third entering orbit; four labials touch first pair of chinshields; posterior chinshields reduced; scales in 17 rows, smooth; ventrals 175; anal divided; subcaudals 31.

Dark grayish brown on dorsal surfaces, the sides and venter paler, the scales being partly yellowish. Total length 850 mm.; tail 86 mm.

A specimen in the U. S. National Museum (No. 13537) from San José, Costa Rica has the rostral much broader than high, one half or more of its surface visible above; internasals fused but with a small entrant suture; prefrontals fused into one scale, 2½ times wider than long; frontal small, as wide as long, shorter than its distance from tip of snout; parietals equal to their distance from tip of snout; nasal single, pierced in the anterior half of scale; the loreal and preocular both enter orbit; two postoculars; supraoculars small; temporals 1 + 2 + 2 (a small scale severed from the front temporal on one side); supralabials 6-6, the third only entering orbit; infralabials 9-8, four touching chinshields; two pairs of chinshields, the first largest, the second pair separated by two scales; scale formula 19-17-15; ventrals 174½; subcaudals 40; anal divided.

The specimen is uniform dark brown, the scale centers lighter on sides of body.

Genus TRIMETOPON Cope

Trimetopon Cope, Proc. Amer. Phil. Soc., vol. 22, 1884, p. 177.

Genotype: *Ablabes gracilis* Günther.

This genus as here considered may be composite. Four forms are known to occur in Costa Rica. The forms of *Trimetopon (sensu strictu),* having 15 scale rows and a fused prefrontal are kept with forms having the prefrontals separated and 17 scale rows.

KEY TO COSTA RICAN SPECIES OF TRIMETOPON

1. Prefrontals fused; scales in 15 rows..... 3
   Prefrontals fused or separate; scales in 17 rows..... 2
2. Prefrontals separate; seven supralabials; throat white, venter red; a black streak from eye to suture of fourth and fifth labials; ventrals 163; subcaudals 33.....*viquezi*
   Prefrontals fused; eight supralabials; ventrals 154 ♂; subcaudals 69; throat and venter yellow; no apical pits; first chinshields twice size of second pair.....*pliolepis*
3. Ventrals 122, subcaudals 69; one preocular, two postoculars; seven supralabials; black above, and white below on venter; head white as far forward as middle of frontal including third labial; a black spot on seventh labial.....*simile*
   Ventrals 141-149; subcaudals 60-69 (65); a tendency to form lateral dark stripes; a neck band; single apical pits; chinshields subequal in size; yellowish below...*gracile*

Trimetopon pliolepis Cope

Trimetopon pliolepis Cope, Proc. Acad. Nat. Sci. Philadelphia, 1894, p. 201; Boulenger, Catalogue of the Snakes in the British Museum, vol. 3, p. 636.

Trimetopon gracile (part.) Dunn, Copeia, 1937, no. 4, pp. 214-215 (The part referable is the *Trimetopon plioplepsis* [*sic*] stated by Dunn to have appeared in Cope, Proc. Amer. Philos. Soc. 22, 1885:177. This is incorrect since the species was not described until 1894, and in another publication. See above).

Rostral not visible above, small internasals much wider than long; anterior border of frontal slightly convex forward; lateral border of frontal shorter than the parietal border, "which forms less than a right angle with that of the opposite side"; loreal longer than high; one preocular well separated from frontal; one postocular; temporals 1 + 1; supralabials 8, fourth and fifth entering orbit, all longer than high except eighth; infralabials 8; posterior chinshields half size of anterior pair; scales 17, without pits (fossae).

Total length 287 mm.; tail 76 mm.; ventrals 154; anal divided; subcaudals 69.

Dark brown above, the scales with a paler, minutely speckled center except those of third row; this, together with the more restricted pale centers of the scales of the first and second rows gives the appearance of a dark lateral band which tips the ventrals. Below uniform yellow; a narrow yellow collar borders but does not cross the extremities of the parietals; each upper labial with a large yellow spot next the border; that at the top of the sixth and the front of the seventh has the effect of a postocular band. (From type description.)

Cope does not specifically state that the prefrontals are fused but one infers this since he does not mention any difference in this respect from *gracile* when he compares the forms.

Two specimens were collected in Costa Rica. R.T.C. No. 655 was taken at Isla Bonita at approximately 5500 ft. elevation and R.C.T. No. 1458 was taken at Los Diamantes at about 900 ft. elevation by Richard C. Taylor. The difference in elevation is nearly 4600 feet. Both are referred to this species despite certain discrepancies in characters.

No. 1458 ♀. The following scale characters obtain: part of rostral visible above, a broad triangle, much smaller than an internasal; internasals small, the common suture one-fourth times as long as the fused prefrontals; latter scale not twice as wide as long, minutely entering eye, its posterior edge nearly a straight transverse line; pentagonal, its width four-fifths of the length, its length one-fourth greater than its distance from the snout tip; parietals very large,

the length one-fifth to one-fourth greater than its distance from snout tip; nasal at least partially separated; loreal present, longer than high; a small preocular; supraocular about one third of the width of the frontal; one postocular; temporals 1 + 1 + 2; supralabials eight, the fourth and fifth border eye; infralabials 7-8, there being four (or five) touching the anterior chinshields; latter scales twice as long as posterior and more than twice their area; scale formula, 17-17-17, all smooth without pits; ventrals 141; subcaudals 59; anal divided; total length, 228 mm.; tail 60 mm.

Above brown, the edges of the scales having deeper brown or blackish edges, the centers being light brown or fawn resulting in a pattern of indistinct dark and light lines. These dark lines vary in thickness; one on lower and one on upper edge of first scale row; one on edges of third and fourth rows; a narrower line on edges of sixth and seventh; the median scale row is almost entirely dark.

The light lines on first and second rows are most distinct; two lower dark lines merge into a single dark line on base of tail; head brown flecked and mottled with fawn; a pair of narrow light spots converge on the back point of frontal; first supralabials with irregular cream spots; a larger more prominent spot on sixth labial but extending onto adjoining scales; dark spots on infralabials; a distinct cream bar across neck; chin, venter, and under side of tail cream; the extreme outer edges of ventrals dark brown.

No. 655, differs in a few characters. The anterior part of frontal forms a curved line. On right side third and fourth labials are fused, thus only third labial enters eye; on left side the third labial transversely severed thus making an "extra" loreal. The part of rostral visible above smaller than in preceding specimen; labial markings nearly the same, and light markings on frontal borders only dimly evident; temporals 1 + 1 + 1; scales 17-17-17; ventrals 143; subcaudals 73. Total length, 242 mm.; tail 73 mm. The frontal region is somewhat broader, and the dark stripes are only dimly evident. The length of the labials in relation to height varies somewhat from the type.

I examined two specimens at the Harvard Museum of Comparative Zoology from La Palma, Costa Rica collected and identified by Dunn as *Trimetopon gracile*.

These are Harvard M.C.Z. No. 28049 (with 148½ ventrals, tail incomplete; 8-8 supralabials, 8-8 infralabials; prefrontals fused; scales 17-17-17 rows; second chinshields small, about one-third size of first pair; keels present above anal region) and No. 28050 (ventrals 148; subcaudals 69; a white line from eye to lip).

A specimen in the U. S. National Museum, No. 75036 from San José, Costa Rica has the following characters: rostral narrowly visible above; internasals small, their length in prefrontal length approximately 2-2 5 times; prefrontals fused, twice (or more) size of frontal; frontal equals its distance to snout tip; parietals elongate, one-sixth longer than snout; loreal longer than high; one preocular, one postocular, the latter distinctly the larger; temporals 1-1; 8-8 supralabials; 8-8 infralabials, five touch first chinshields which are thrice area of second pair; first labials form a suture; 153 ventrals (the first separated from the posterior chinshields by four scales); anal divided; subcaudals 70 + 1.

A nuchal band, divided; a pair of symmetrical white spots on back of frontal and a similar pair on edges of parietals; an irregular white line crosses snout on rostral and internasals, goes onto labials terminating at lip; a light spot below eye to seventh labial; head otherwise brown flecked; chin immaculate except mental and the two labials on each side; body scales brown with elongate dashlike lines of varying width thus appearing as light and dark stripes of varying width and distinctness; body color encroaches on ventrals but venter chiefly immaculate cream white.

Trimetopon viquezi Dunn

Trimetopon viquezi Dunn, Copeia, 1937, no. 4, p. 215 (type locality, Siquirres, Costa Rica).

The following characters appear in the type description: Nasal semidivided; two prefrontals; one preocular, two postoculars; temporals 1-1; supralabials seven, the third and fourth border orbit; infralabials eight, four touching the anterior chinshields which are separated from the mental and are longer than the posterior; dorsal scales in 17-17 smooth rows, save a few keeled scales on sides above anus; ventrals 161 + 2; caudals 33 +. The total length is 209 + (part of tail missing).

Black above, each scale with a white streak at base except those of the vertebral and the fourth row, resulting in a dark vertebral line and a dark lateral line; throat white; belly and under side of tail red; a black streak from eye to suture of labials four and five; a white streak from eye onto the sixth and seventh labials; a white streak from side of neck crosses the seventh labial; anterior labials spotted black and white.

I have not seen the type, which is from Siquirres, Costa Rica.

Trimetopon simile Dunn

Trimetopon simile Dunn, Occ. Papers Boston Soc. Nat. Hist., vol. 5, 1930, p. 331 (type locality, Reventazón, Costa Rica [= La Junta], later stated to be Siquirres).

Prefrontals fused into a single large scale. Scales in 15 rows; one preocular; two postoculars; temporals 1 + 1; supralabials seven, the third and fourth border eye; infralabials seven, four touching the anterior chinshields, which are longer than posterior pair.

Ventrals 122; anal divided; subcaudals 69. Black above, white on ventral surface; head white as far forward as middle of frontal and including third labial; a black spot on seventh labial. Total length, 155 mm.; tail, 50 mm.

I have seen only the type.

Trimetopon gracile (Günther)

Ablabes gracilis Günther, Ann. Mag. Nat. Hist., ser. 4, vol. 9, Jan. 1872, p. 18, pl. 3, fig. D ("Elevated country near Cartago").

Trimetopon gracile Boulenger, Catalogue of the Snakes in the British Museum, vol. 2, pp. 184-185 (Boulenger gives the count of ventrals as 141-149 for the two cotypes, and 60-65 for the subcaudal counts; that given in the type description is ventrals 149, subcaudals 69); Dunn, Copeia, 1937, no. 4, Dec. 31, pp. 214-215.

The characters of the type are: body and tail slender, subcylindrical; head narrow, not distinct from neck; rounded rostral very broad and low; very small narrow internasals; prefrontals fused into a single large scale; frontal broad and long, five-sided with the posterior angle produced and pointed; parietal length equal to frontal and prefrontal length together; nostril between two small nasals; loreal longer than high; one preocular not reaching upper surface of snout; one postocular; seven supralabials, the third and fourth border eye; temporals 1+1+2; first infralabials in contact; chinshields, two pairs subequal in size; scales 15 rows, smooth, with single apical pits; ventrals 149, subcaudals 69. Length approximately 300 mm.

Upper parts nearly uniform blackish brown, the anterior and lateral scales somewhat lighter in the center; an indistinct narrow brownish collar; lower parts yellowish.

Boulenger, *loc. cit.*, adds certain data, presumably taking into consideration a second specimen: "seven or eight upper labials, third and fourth or fourth and fifth entering the eye; four or five lower labials in contact with the anterior chin-shields, which are longer than the posterior."

As for the color, Boulenger states, "Dark brown above, with five blackish longitudinal lines; a more or less distinct yellowish collar;

lateral scales lighter in the centre; labials yellowish, spotted with black; lower parts uniform whitish."

Günther's figure shows the anterior and posterior chinshields as of approximately the same size, and the parietal longer than its distance from the tip of the snout.

Genus HYPSIGLENA Cope

Hypsiglena Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 12, 1860, p. 246.

Genotype: *Hypsiglena ochrorhynchus* Cope.

A single species occurs in Costa Rica.

Hypsiglena torquata torquata (Günther)

Leptodeira torquata Günther, Ann. Mag. Nat. Hist., ser. 3, vol. 5, Feb. 1860, p. 170, pl. 10, fig. A.

Leptodeira torquata torquata, (*part.*) Dunn, Proc. Nat. Acad. Sci., vol. 22, 1936, p. 694.

Comastes quincunciatus Jan, Iconographie Générale des Ophidiens, livr. 38, 1871, pl. 1, fig. 1 (Costa Rican specimen listed).

Knowledge of the species as a member of the Costa Rican fauna is based on two reports: One is that of Jan, *loc. cit.;* the other is that of a Costa Rican specimen in the Museo Nacional de Costa Rica.

The following characters distinguish the species: snout rounded, obtuse, rostral much broader than deep, the part visible above one fourth to one third its distance from frontal; frontal once and a third to once and a half as long as broad, as long as or a little longer than its distance from end of snout; loreal longer than deep; one preocular; a presubocular; two postoculars; temporals 1+2; eight (exceptionally seven) upper labials, fourth and fifth (third and fourth) entering eye; five infralabials touch first chinshields, which are shorter than posterior pair; scales in 21 rows; ventrals 169-174; anal divided; subcaudals 41-55.

Grayish or pale brown above, with a dorsal row, or two alternating series of dark brown spots separated by yellowish interspaces; sides with two or three alternating series of small dark brown spots; a large dark brown blotch on the nape preceded by a yellow collar; a dark brown streak on each side of the head passing through the eye; head speckled with dark brown; lower parts white. Total length 400 mm.; tail 60 mm.

Genus AMASTRIDIUM Cope

Amastridium Cope, Proc. Acad. Nat. Sci Philadelphia, 1860, p. 370.

Genotype: *Amastridium veliferum* Cope.

Only one species has been reported from Costa Rica.

Amastridium veliferum Cope

Amastridium veliferum Cope, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 370 (type locality, "Cocuyas de Veraguas, N. Grenâda" = Coyucas, Panamá); Proc. Amer. Philos. Soc., vol. 23, 1886, p. 495; Amer. Nat., vol. 26, 1892, p. 481, and vol. 28, 1894, p. 840; Rept. U. S. Nat. Mus., 1898, pl. 24, fig. 13; Boulenger, Catalogue of the Snakes in the British Museum, ed. 2, vol. 2, 1894, p. 352; Dunn, Proc. U. S. Nat. Mus., vol. 65, 1924, p. 1-3 (Cariblanco, Costa Rica, etc.).

?Fleischmannia obscura Boettger, Katalog der Reptilien-Sammlung in Museum der Senckenbergischen Naturforschenden Gesellschaft in Frankfurt Am. Main. Teil II, (Schlangen) 1898, p. 69 (type locality, San José, Costa Rica).

?Phrydops melas Boulenger, Ann. Mag. Nat. Hist., ser. 7, vol. 15, May 1905, pp. 453-454 (Carriblanco, Costa Rica).

Phydrops melas (*sic*) Dunn, Copeia, 1391, no. 4, p. 163.

The characters by which this snake may be diagnosed are as follows: 12 maxillary teeth, the last one or two largest, not grooved; pupil round; no loreal; scales in 17 rows, smooth anteriorly, lightly keeled posteriorly, lacking pits, subcaudals divided.

Rostral scarcely visible above; internasals two-thirds times as long as the prefrontals; frontal longer than its distance from snout tip; one preocular; temporals, 1+2; seven supralabials, third and fourth enter eye; nine infralabials; ventrals 123-127; subcaudals 79-85; anal divided.

Above and below reddish brown, paler on center of ventrals; every fourth scale of the fifth row on each side pale, the adjacent scales on the fourth and sixth rows generally darker; top of head much lighter, varied anteriorly, palest behind eye and above labials; latter dark with a few light spots. Total length 355 mm.; tail, 120 mm.

I have examined a Harvard specimen (M. C. Z. No. 15319). The following characters are in evidence: scale formula 17-17-17; no loreal present; nasal single, the posterior end slightly higher than anterior; eye larger than its distance from rostral; one large squarish preocular, two postoculars; 7-7 supralabials, the third and fourth enter orbit; infralabials 9-9, 4 touch chinshields; fifth supralabials touches the parietal narrowly, the first temporal thus being separated from the postoculars; frontal narrow, twice as long as wide; temporals 1+2 (the two upper fused on one side); ventrals 136; anal divided; 48+ subcaudals.

Color of head and neck yellow-brown, the dark body color running forward to a point on the posterior edge of the parietals; fourth and seventh scale rows with darker lines made up of short dashlike marks; venter dark. A row of cream colored dots on the fifth scale row scarcely discernible.

Records of the snake for Costa Rica are: a specimen in the Museum of Comparative Zoology, Harvard College, from Cariblanco, Costa Rica; that of the type specimen of *Fleischmannia obscura* from San José, Costa Rica and the type of Boulenger's *Phrydops melas* from Cariblanco, Costa Rica.

Genus SPILOTES Wagler

Spilotes Wagler, Natürliches System der Amphibien, 1830, p. 179.

Genotype: *Coluber pullatus* Linnaeus.

Two forms of *Spilotes* occur in Costa Rica. These are usually considered as subspecies of *pullatus*. There is, however, doubt that *mexicanus* and *pullatus* intergrade where they meet. This group definitely is in need of a revision.

KEY TO FORMS OF COSTA RICAN SPILOTES

Yellow markings confined largely to the anterior part of body; latter part nearly uniform black; supralabials 7 (usually).....*pullatus pullatus*
Yellow markings of body extending to end of tail; supralabials 8.....*pullatus mexicanus*

Spilotes pullatus pullatus (Linnaeus)

Coluber pullatus Linnaeus, Museum Adolphi Friderici Regis, 1754, p. 35, pl. 20, fig. 3 (Asia, in error).
Spilotes pullatus Wagler, Natürliches System der Amphibien, 1830, p. 179.
Spilotes pullatus pullatus Dunn and Bailey, Bull. Mus. Comp. Zool. Harvard Coll., vol. 86, 1939, p. 18.

Two specimens of this large tree snake were captured, one (M. N. H. No. 25757) June 26, 1947, along the Reventazón River about 3 km. southwest of Turrialba, and one (M. N. H. No. 25756) July 19, near the same locality.

The head in each is banded with yellow but the yellow markings on body are greatly reduced, only traces being evident in a few small dashlike marks on a few scales. On the anterior part of the body, the ventrals are about half yellow; farther back the yellow is reduced so that only half of a ventral may be affected, and at ventral number 106 and 122 respectively the color ceases to have any yellow and from there to end of tail the color is uniform black. The ventral counts of the two specimens are 226, 221; subcaudals, 113 + and 74 + respectively.

The following characters also obtain: rostral scarcely visible above; internasals about one-fourth shorter than prefrontals; length of frontal slightly less than its distance to end of snout, about as wide as long, one-fourth shorter than parietals; length of latter scales less than their distance to internasals; loreal very small, about as long as high; preocular very large, minutely separated from frontal

scale; two postoculars; temporals, 1 + 1 + 1 (1 + 1); supralabials, 7-7, fourth and fifth entering eye; infralabials, 8-8, four touch chinshields, which are much larger than second pair. Scale rows keeled except outer, the formula 14-16-10; paired or single apical pits are present.

The tail of No. 25757 appears to be perfectly normal, the terminal scute being well developed. However its thickness at the tip suggests a well-repaired break. Moreover the number of subcaudals is 39 less than in the other specimen and that one has the extreme tip missing. No. 25756 has a more or less symmetrical pair of scales segmented from the inner parts of the parietals, that on the right being partially fused to the parent scale.

A specimen in the U. S. National Museum (No. 32650, Costa Rica) has the head largely black, with a neck band of yellow. A yellow stripe crossing head just behind the eyes is interrupted across the top of the head. There are yellow spots on rostral, nasals, prefrontals, internasals, supraoculars and frontal. The ventrals are black and yellow, the yellow predominating anteriorly, the latter half of body and tail uniform black. Ventrals 218, subcaudals 118.

Spilotes pullatus mexicanus (Laurenti)

Cerastes mexicanus Laurenti, Specimen Medicum exhibens Synopsin Reptilium emendatum. 1768, p. 82.

Spilotes pullatus mexicanus Amaral, Mem. Inst. Butantan, vol. 4, 1929, pp. 282-284 (Mexico to Nicaragua).

Spilotes pullatus auribundus Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 13, 1861, p. 300.

Amaral in his review of the Genus *Spilotes* characterizes this presumed subspecies as having a loreal, eight supralabials, the fourth and fifth entering eye orbit; temporals 1 + 1 or 1 + 2; ventrals 204-222; subcaudals 115-138; scale rows 18 (19) around middle of body.

The presence in Costa Rica of specimens of this subspecies, if indeed it is related subspecifically to *pullatus*, is attested by certain specimens in the U. S. National Museum: Nos. 37724, 37725, and 37726, Esparta, Costa Rica.

No. 37725 has the supralabials 8-8; scale rows 16-16-16-12; ventrals 220; subcaudals 134. The yellow banding of the head and body continues on to the tail, the black interspaces are of about 7 scale lengths, the yellow 3 or 4 scale lengths.

No. 37726 is a young specimen with the body coloring forming strongly-defined body bands, and in appearance is very different from that of the adult.

Genus THALEROPHIS Oliver

Thalerophis Oliver, Copeia, 1947, p. 64.

Genotype: *Coluber richardi* Bory St. Vincent.

The group of tree snakes long known under the genus *Leptophis* are here treated under the genus *Thalerophis* since the name *Leptophis* is not available. The species belonging in the genus have recently been reviewed by Dr. James Oliver * and several nominal species formerly believed to occur in Costa Rica are reduced to synonymy. Thus *aeruginosus* Cope, *bilineata* Günther and *saturatus* Cope are regarded as synonyms of *T. depressirostris* Cope; and *ultramarinus* is regarded as a synonym of *T. richardi occidentalis* Günther.

The following four species are recognized as occuring in Costa Rica: *depressirostris, mexicanus mexicanus, nebulosus, richardi occidentalis,* and these may be differentiated on the basis of the following synopsis.

SYNOPSIS OF COSTA RICAN SPECIES OF THALEROPHIS

1. Loreal normally present 2
   Loreal normally absent 3
2. A strong black stripe from snout through eye and onto side of body; body scale rows keeled except outer; ventrals: in males 148-169, average about 157; in females 154-174, average about 161; maxillary teeth 20-25 (average 21), last two enlarged ..... *mexicanus mexicanus*
   No black stripe beginning on snout; a short stripe beginning behind eye terminates back of the jaw angle; two paravertebral scale rows keeled, others smooth; ventrals 144-158; nine supralabials; maxillary teeth 33-36, the last three or four enlarged ..... *depressirostris*
3. A dark stripe on lores continued back of eye to jaw angle; a greenish blue, or blue dorsolateral stripe on third and fourth scale rows (or third, fourth and fifth); ventrals: males 150-160, female 158; maxillary teeth 28-29, the last three enlarged ..... *nebulosus*
   No dark mark in front of eye; top of head dark blue or greenish blue, which color extends over the body; ventrals: males 158-177, females 161-181; maxillary teeth 18-25 (average about 21); supralabials 8 or 9 ..... *richardi occidentalis*

Thalerophis mexicanus mexicanus (Duméril, Bibron and Duméril)

Leptophis mexicanus Duméril, Bibron and Duméril, Erpétologie Générale . . . , vol. 7, pt. 1, p. 536 (type locality, Mexico.)

Thalerophis mexicanus mexicanus Oliver, Bull. Amer. Mus. Nat. Hist., 1948, pp. 211-217.

Rostral broader than high barely visible from above; internasals usually a little shorter than the prefrontals; frontal once and one third to once and two thirds as long as broad, as long as its distance from the end of the snout, shorter than parietals; nasal elongate, at least partially divided; loreal present, at least twice as long as high; one preocular, very large but not reaching frontal; two postoculars;

* The Relationships and Zoogeography of the Genus Thalerophis. Oliver, Bull. Amer. Mus. Nat. Hist., vol. 92, 1948, pp. 161-280.

temporals 1+2; eight supralabials, fourth and fifth entering eye; usually 10 infralabials. Scales in 15-15-11 rows, keeled save on outer rows.

Green or dark greenish blue above; a narrow black stripe along the side of head passing through eye, continues along the side of the body and tail, varying somewhat in width and intensity. When outer epidermis is present the color on sides and dorsum is brownish to bronze-brown; when it is removed the general color is greenish blue to greenish or olive brown; belly white.

This species has been reported from San José; other specimens are reported, labeled only "Costa Rica" without definite locality.

Thalerophis depressirostris (Cope)

Philothamnus depressirostris Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 12, 1860, p. 557 (Cocuyas de Veraguas, Colombia).

Diplotropis bilineata Günther, Ann. Mag. Nat. Hist., ser. 4, vol. 9, 1872, p. 24, pl. 6, fig. B (type locality, Costa Rica).

Leptophis aeruginosus Cope, Journ. Acad. Nat. Sci. Philadelphia, vol. 8, 1876, p. 132 (type locality, Costa Rica).

Leptophis saturatus Cope, Journ. Acad. Nat. Sci. Philadelphia, vol. 8, 1876 (1875) p. 133 (type locality, Sipurio, Costa Rica).

Thalerophis depressirostris Oliver, Bull. Amer. Mus. Nat. Hist., vol. 92, 1948, pp. 203-207, figs. 1G, 4, 8, and plate 16 (figure on right).

This species is represented by a single specimen, M. N. H. No. 25704, collected by Prof. Marco Tullio Pacheco, and presented to me. It was found near Peralta at an elevation of 300 meters. The following scale characteristics are present:

Rostral visible above as a small triangle; internasals as long as prefrontals; frontal more than one fourth longer than wide, its length about equal to its distance from end of snout; length of parietal about equal to its distance from internasal; nasal nearly equally divided; loreal twice as long as wide; preocular large, well separated from frontal; two postoculars; temporals 1+2; supralabials 8-9, the fifth and sixth (fourth and fifth) bordering eye; infralabials 10-10, five bordering the chinshields; scale formula, 17-15-11; the scales smooth except the two rows bordering the single median row; indistinct apical pits on some scales; ventrals 147; tip of tail lost; anal divided.

Thalerophis nebulosus (Oliver)

Leptophis nebulosus Oliver, Occ. Papers Mus. Zool., Univ. Michigan, no. 462, 1942, p. 12, fig. 4 (second figure p. 192) (type locality, Cariblanco, Costa Rica).

Loreal absent; a single preocular, touching or narrowly missing contact with frontal; frontal large, length approximately equal to that of interparietal suture; temporals 1 + 2; eye equal to its distance

from anterior border of nostril; eight supralabials normally; infralabials ten (usually); scale formula, 15-15-11, keeled save on outer row. Ventrals 150-160; subcaudals 145-151; anal plate divided.

Top of head bluish green; a narrow black stripe beginning on upper edge of first or second labial passing back through eye and for a short distance on the side of the body. Body color cream-white on outer scale rows, the next three rows bright blue; scales on head, below the black stripe, white or cream; venter and chin cream.

Only the type is known from Costa Rica.

Thalerophis richardi occidentalis (Günther)

Ahaetulla occidentalis Günther, Proc. Zool. Soc. London, 1859, p. 412 (type locality, Guayaquil and western Equador).

Thalerophis richardi occidentalis Oliver, Bull. Amer. Mus. Nat. Hist., vol. 92, 1948, pp. 241-245.

Leptophis ultramarinus Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 46, 1894, p. 204 (type locality, Pozo Azul, Costa Rica).

Loreal shield normally absent; normally one preocular in contact with the frontal; two postoculars; supralabials eight or nine, frontal large; temporals 1+2; infralabials usually ten; scale rows 15-15-11, all keeled save outer one or two rows, and the keels may be lacking from the median row; ventrals: males 152-177, females 161-182; subcaudals: males 153-189, females 161-175.

Color of head dark blue to greenish blue, this color extending onto body and tail, extending even to outer edges of ventrals; infralabials, chin and venter pale greenish blue to yellowish white.

Reported from Barranca, Buenos Ayres, Colorado Bar, Limón, Pozo Azul, and Siquirres.

I have examined an uncatalogued specimen of this species in the U. S. National Museum collected 2 mi. SE of Turrialba, Costa Rica. It has the following characters: loreal absent; supralabials 9-9, the fifth and sixth entering orbit; one preocular, two postoculars; 10-11 infralabials, five touching the first chinshields which are shorter than second pair; three labials touch prefrontals; eye large, equal to its distance to front edge of nostril; frontal equal to its distance to snout tip; ventrals 172; subcaudals 173+; scales 15-15-11, the scale rows bordering the median row strongly keeled as is the adjoining row; outer scales smooth but each with a median black line simulating a keel.

Genus DRYADOPHIS Stuart

Dryadophis Stuart, Copeia, No. 1, 1939, p. 55.

Genotype: *Coluber boddaerti* Sentzen.

Only a single species is known to occur in Costa Rica.

Dryadophis melanolomus alternatus (Bocourt)

Coryphodon alternatus Bocourt, Bull. Soc. Philom., ser. 7, vol. 8, 1884, pp. 133-142, and Etudes sur les Reptiles; Mission Scientifique au Mexique et dans l'Amérique Centrale, livr. 11, 1888, pl. 45, fig. 3a-e (not mentioned in text).

Drymobius alternatus Cope, Bull. U. S. Nat. Mus., no. 32, 1887, p. 70.

Dryadophis melanolomus alternatus Stuart, Misc. Publ. Mus. Zool., Univ. Michigan, no. 49, Mar. 17, 1941, pp. 81-86.

The specimen described by Bocourt, or at least the specimen figured by Bocourt, for *Dryadophis alternatus* is strikingly different from the species considered under this name by Stuart in his revision of the genus, *loc. cit.* Bocourt's figure is of a snake with well-defined quadrangular dorsal blotches alternating with a lateral series of somewhat smaller quadrangular blotches. Under this name Stuart treats of a snake that is uniformly colored. It is presumed that the young have a pattern differing from adults, and the specimen depicted by Bocourt was a juvenile.

Of the five specimens at hand, R. C. T. Nos. 417 and 656 are from Turrialba, elev. about 1900 ft.; R. C. T. No. 968 from San Isidro El General, elev. about 2000 ft.; and R. C. T. Nos. 1437 and 1438 from Los Diamantes, about 2 kilometers south of Guápiles, at an elevation of about 800 feet.

Specimens from Los Diamantes were olive in life; the ventral color being immaculate pinkish. The sides of the ventrals are subangular; however there is no decided keel present. The outer edges of the ventrals were gray-olive in life. With a loss of the outer epidermis the specimens now are uniform gray-blue. When placed under water, the scales appear slightly darker on their edges. The pink color is still present on the ventrals. Neither of the two specimens displays any transverse banding or longitudinal lineation. One of these has an undivided anal scale.

The two specimens, Nos. 417, 656 differ somewhat. In life they were olive above without markings, the venter with a yellow wash and the throat and chin bluish gray with small yellow spots. All trace of olive and yellow has now disappeared, leaving the dorsum dull grayish blue, the venter dirty white with the edges of the ventrals clouded with gray. The chin spots are cream-white. An indistinct median zigzag line is present under the tail.

The small specimen from San Isidro El General when first examined was olive in color but with some slight indication of darker crossbars on the anterior part of the body, and a faint indication of a light lateral stripe. In the preserved specimen with outer epidermis removed, no trace of the crossbands remains; but submerged in water there are visible certain darker and lighter stripes; a dim light stripe is present on the fourth and slightly on the fifth scale row. The third scale row is bordered by darker color, tending to form a dark longitudinal line. The first and second scale rows are a little lighter than surrounding scales so that a dim lighter stripe is evident here. The lower edges of the first row and outer edges of the ventrals are darker than the remainder of the scale and another dim, dark line is evident. Ventrals angular, the outer, turned-up edges blue-gray, the ventral portion being finely mottled with light gray. On the angular keel a light line is more or less evident.

DATA ON DRYADOPHIS MELANOLOMUS ALTERNATUS (Bocourt)

No.	Sex	Ventrals	Subcaudals	Supralabials	Labials enter eye	Infralabials
1438	♂	182	97	9–9	4, 5, 6	10–10
1437	♂	180	96	9–9	4, 5, 6	10–10
417	♂	175	91	9–9	4, 5, 6	11–11
656	♂	179	101	9–9	4, 5, 6	10–11
968	♂	176	108	8–9	4, 5, 6 (3, 4, 5)	9–10

DATA ON DRYADOPHIS MELANOLOMUS ALTERNATUS (Bocourt) (concluded)

No.	Labials touch chinshields	Temporals	Scale rows	Anal	Ventrals keeled	Ventrals color
1438	5	2 + 2	17–17–15	2	slightly	reddish
1437	5	2 + 2	17–17–15	1	slightly	reddish
417	5	2 + 2	17–17–15	2	not	gray
656	5	2 + 2	17–17–15	2	not	gray
968	5	2 + 2	17–17–15	2	not	gray

Genus DRYMOBIUS Fitzinger

Drymobius Fitzinger, Systema Reptilium, 1843, p. 26.

Genotype: *Herpetodryas margaritiferus* Schlegel. Four species are recognized in Costa Rica.

KEY TO SPECIES OF DRYMOBIUS IN COSTA RICA

1. Body with a series of brown saddlelike blotches, alternating with smaller lateral spots; ventrals 146-152; subcaudals 88-91 ..... *rhombifer*
   Body not marked with blotches, but generally black or green 2
2. Body black, each scale with a dashlike green or yellow-green mark; ventrals 146-149; subcaudals 109-117 ..... *margaritiferus margaritiferus*
   Body green; belly more or less yellowish in life 3
3. Body green, the color encroaching on ventrals; keels of three median rows black ..... *melanotropis*
   Body green, the keels of the median rows not black ..... *chloroticus*

Drymobius margaritiferus margaritiferus (Schlegel)

Herpetodryas margaritiferus Schlegel, Essai sur la physionomie des serpens, vol. 2, 1837, p. 184.
Drymobius margaritiferus [*margaritiferus*] Bocourt, Etudes sur les reptiles; Mission Scientifique au Mexique et dans l'Amérique Centrale, livr. 12, 1890, pp. 716-718, pl. 49, fig. 2.

This common, widespread species is represented by three specimens. M.N.H. No. 25701, an adult male, was captured as it attempted to cross the road in front of our car, five kilometers southwest of Turrialba. A young specimen (R.C.T. No. 205) was taken three kilometers west of Turrialba. A third specimen (M.N.H. No. 25165) in the University collection was obtained five kilometers southwest of Turrialba in 1947 by Mr. Howard Westman.

The characteristics of the young (No. 205) follow: a greenish white longitudinal mark on the frontal; a pair of greenish white lines curving behind last labial and extending to parietal; following this a large series of vertical greenish white and black lines running up on the sides to near the mid-line, a line occasionally meeting its fellow, but more commonly alternating with it. These lines gradually more indistinct on latter half of body where light and dark colors tend to form indefinite longitudinal lines, the most distinct being the greenish white line on the two outer scale rows that terminate at anus; ends of ventrals blackish; the free edge of the scales may be blackish for a greater or lesser distance, rarely crossing ventral; supralabials with black sutures; infralabials and chin greenish cream.

In the two adults the color is blackish, each scale with a small dashlike greenish or greenish-white spot near the center, the greenish spots becoming regularly larger on lower (outer) rows; black on ventrals often across the posterior part of scale; spots on No. 26165 slightly larger and more distinct than those on No. 25701.

I have examined four Costa Rican specimens in the U. S. National Museum; three of these have a ventral scale count of 148; one has 147.

DATA ON DRYMOBIUS MARGARITIFERUS MARGARITIFERUS

No.	Sex or age	Supralabials	Infralabials	Ventrals	Subcaudals	Scale formula
205	yg.	9– 9	11–10	148	. . .	17–17–15
25701	♂	9– 9	11–11	146	109	17–17–15
25165	♂	9–10	10–11	149	117	17–17–15

Drymobius rhombifer (Günther)

Coryphodon rhombifer Günther, Proc. Zool. Soc. London, 1860, p. 236 (type locality, Esmeraldas, Ecuador).
Drymobius rhombifer Peters, Monatsb. Akad. Wiss. Berlin, 1879, p. 777.

Two specimens of this species (M.N.H. Nos. 25734, 25744) were obtained at Turrialba. The following characters are present in the

species; rostral about one fifth wider than high, the area visible above, small, its length about one third the length of internasals; length of latter three fourths of prefrontals, which are one fifth wider than long; frontal one fourth longer than wide, its length equal to its distance from tip of snout or slightly less; parietals short, their width two thirds of their length; nasal divided; posterior part higher and shorter than anterior; loreal a little longer than high; one preocular not reaching frontal; two postoculars; temporals 2 + 2; supralabials 9-9, the fourth, fifth and sixth entering eye; infralabials 9-9, five touching first chinshields, which are a little shorter than second pair; scale formula: 17-17-15, keeled lightly; ventrals 152; subcaudals 88; anal divided.

A series of dark-brown, saddlelike blotches present reaching to ventrals where they border a black ventral spot; between these latter are small (often) triangular spots touching two or three ventral black spots, the apex reaching as high as fifth lateral scale row.

Belly with an irregular series of black blotches along the outer part of ventrals rarely more than one scale wide; between these on middle of venter small scattered black spots. On the brown blotches, each scale edged with black. Chin and throat immaculate, lower part of supralabials nearly white.

The smaller specimen is quite similar. The ventrals are about 146 (injured), the subcaudals 91. The dorsal head scales have deep black spots or punctations. In both specimens there is a somewhat lighter area on each parietal.

This is a South American species that has entered Costa Rica. The greater part of the range is in Colombia, Ecuador and Perú.

Drymobius chloroticus (Cope)

Dendrophidium chloroticum Cope, Proc. Amer. Philos. Soc., vol. 23, 1886, p. 278 (Guatemala).
Drymobius chloroticus Boulenger, Catalogue of the Snakes in the British Museum, vol. 2, 1894, pp. 16-17.

Two specimens were collected at Isla Bonita, one, R.C.T. No. 702, an adult female, and R.C.T. No. 654, a young male.

Data taken from the larger, female specimen follows: part of rostral visible above less than half length of internasals; latter scales only a little shorter than the prefrontals; frontal one fourth longer than wide, its length equal to its distance to end of snout or slightly more; length of parietal equal to its distance from internasal; nasal divided, the anterior part the larger; loreal nearly twice as wide as high; one preocular, very large, widely separated from frontal; two postoculars; temporals 2 + 2; supralabials, 9-9, the fourth, fifth and

sixth border eye; infralabials, 10-11, the first five touching first chinshields, which are about three fifths the length of second pair; ventrals, 186; anal divided; subcaudals, 121. Scales keeled, the formula, 17-17-15 with paired pits. Maxillary teeth about 31, increasing a little in length and size posteriorly.

The second specimen, No. 654, has the infralabials 9-9; the ventrals 186; the subcaudals 100, the tail seemingly complete.

In preservative the specimens are uniform bluish gray above, the belly greenish yellow, each ventral and subcaudal bordered by blackish. In life, olive on dorsal and lateral regions, greenish yellow on venter; upper labials (except upper edges) and chin, cream yellow.

Drymobius melanotropis (Cope)

Dendrophidium melanotropis Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875), p. 134, pl. 26, fig. 1 (type locality, Costa Rica).

Drymobius melanotropis Gaige, Hartweg and Stuart, Occ. Papers Mus. Zool. Univ. Michigan, no. 357, 1937, p. 13 (Río Siquia Nicaragua).

Scales in 17 rows, with apical pits present, all keeled except the two outer rows, the keels on the paravertebral rows strongest; rostral broader than deep; frontal bell-shaped, wide in front, contracted behind, as long as the parietals; loreal much longer than high; one preocular, one subocular; two postoculars; temporals 2 + 2; nine supralabials, the fourth, fifth and sixth bordering orbit; ventrals 152-163, not angulate; subcaudals 91-96; anal divided.

Green above and on sides, the color occupying the outer fourth of the ventral scales. Yellow on venter; keels of three median rows black.

Genus DENDROPHIDION Fitzinger

Dendrophidion Fitzinger, Systema Reptilium, 1843, p. 26.

Genotype: *Herpetodryas dendrophis* Schegel.

Two species are known from Costa Rica.

KEY TO THE COSTA RICAN SPECIES OF DENDROPHIDION

Ventrals 150-175; subcaudals 113-155; olive brown, uniform or with blackish cross-bands enclosing rounded whitish spots, or with whitish black-edged cross-bands; upper lip whitish or yellow ..... *dendrophis*

Ventrals 183; subcaudals 127; color brown, without markings; below yellow; upper lip partly yellow ..... *paucicarinatus*

Dendrophidion paucicarinatus (Cope)

Drymobius paucicarinatus Cope, Proc. Acad. Nat Sci. Philadelphia, 1894, pp. 202-203 (type locality, La Candelaria, Costa Rica).

Scales in 17 rows, five median rows faintly keeled, others smooth; one preocular, not reaching frontal; two postoculars; loreal sub-

quadrate, longer than high; temporals 1 + 2; four and one-half scales bordering each parietal; supralabials nine, fourth, fifth and sixth border orbit, the eighth and ninth longer than high; eye large, its diameter equaling length of muzzle from its border to the nostril, and equaling a little more than half interocular distance; frontal wide in front, contracting rapidly posteriorly, the lateral borders very little concave; ten infralabials; anterior chinshields shorter than posterior; ventrals 183; subcaudals 127; anal divided.

Color above brown without markings, below yellow; ends of ventrals and a narrow transverse line near base of ventrals lead colored; much of upper lip yellow.

Dendrophidion dendrophis (Schlegel)

Herpetodryas dendrophis Schlegel, Essai sur la physionomie des Serpens, vol. 2, 1837, p. 196. (Also in another work having the same title and date, this name and a synopsis appears on p. 153 with the following data, "Herpetodryas dendrophis. 15 Rangées d'écailles carénées et lancéolées. Dessous de la queue aplati; ventre convexe. 140 + 196? Dessus brun-olivâtre, marqué de nombreuses bandes étroites transverales foncées, que renferment des taches claires. De Cayenne.")

Dendrophidium dendrophis Cope, Proc. Amer. Philos. Soc., vol. 23, 1886, p. 278.

Scales in 17 rows with apical pits. Maxillary teeth in a continuous series 33-50 subequal. Normally supralabials nine, the fourth, fifth and sixth bordering orbit; one preocular, two postoculars; temporals normally 2 + 2, but variable; ventrals 150-175; subcaudals 113-155.

"Olive-brown above, uniform or with blackish cross-bands enclosing rounded whitish spots, or with whitish black-edged cross-bands; upper lip whitish; ventrals and subcaudals olive on the sides, whitish, uniform or dotted or edged with olive in the middle."

Genus PSEUSTES Fitzinger

Pseustes Fitzinger, Systema Reptilium, 1843, p. 27.

Genotype: *Dipsas dieperinkii* Schlegel [= *Pseustes sulphureus sulphureus* (Wagler)].

One species is known in Costa Rica.

Pseustes poecilonotus chrysobronchus (Cope)

Spilotes chrysobronchus Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875), p. 136, pl. 28, figs. 11a, 11b (head only); U. S. Nat. Mus. Bull. no. 32, 1887, p. 71; Bocourt, Etudes sur les reptiles; Mission Scientifique au Mexique, et dans l'Amérique Centrale, livr. 11, 1888, pp. 695-696, pl. 48, figs. 3a, 3b (after Cope) (data from Cope); Günther, Biologia Centrali-Americana; Reptilia and Batrachia, Feb. 1894, p. 119.

Phrynonax chrysobronchus Boulenger, Catalogue of the Snakes in the British Museum (Natural History), vol. 2, p. 22 (data from Cope).

Phrynonax poecilonotus chrysobronchus Amaral, Mem. Inst. Butantan, T. 4, 1929, p. 156 (Costa Rica).

Cope has compared this form with *Spilotes fasciatus* Peters but decides the two are distinct. Boulenger likewise regards the two

as distinct. Günther however suggests that the two forms may be identical.

The single specimen in the collection was obtained by Mr. Charles R. Camp, 5 km. SE of Turrialba, elev. 1950 ft., Province Cartago, Costa Rica.

Head flattened, distinct from neck; rostral a little broader than deep; internasals about two thirds the area of prefrontals; latter scales border loreal but are separated from the supraocular; frontal as long as its distance from the tip of snout, about one fifth longer than wide; parietals short, about as wide as long, equally as long as frontal.

Nasal single, pierced by nostril, but a groove from nostril, to labial suggests a partial division; loreal small, a little longer than wide; one large preocular reaching frontal narrowly, and bordering two labials below; supraocular large, longer than wide; two postoculars; temporals $\frac{2}{1}+2$; eight upper labials, the fourth, fifth, and sixth bordering eye, eighth greatly elongated; 12 lower labials, seven touching first pair of chinshields; these about one fifth shorter than second pair.

Scale formula, 21-25-17-15; scales with paired apical pits, and tending to form diagonal rows on the sides; four median dorsal rows with indistinct keels. Ventrals 211; subcaudals 132; anal single; snout to vent 1115 mm.; tail, 436 mm.; total length 1551 mm.; width of head 43 mm.; snout to rictis oris, 40 mm.

Scales pinkish fawn, each bordered with brown or black. Sometimes entire scale is bordered, sometimes only a part, the border varying in width, and thus developing a more or less distinct pattern of indistinct, dark, diagonal blotches joining medially; supralabials, infralabials, chin, throat and anterior one fourth of venter yellowish white, there being a few black dots on outer edge of ventrals, which more posteriorly encroach on the middle of ventrals until they form continuous transverse black borders on each ventral, and still farther back tend to cover the entire scale. Top and side of head dark.

Variation: The total ventral-subcaudal count for one of the cotypes is 337 (ventrals, 220, subcaudals, 117). In the described specimen the total is 343 (ventrals 211, subcaudals 132). This specimen is a female; I presume that the cotype specimen is also a female. The tail in the cotype is proportionally shorter and the body longer (1670 mm., to 422 mm.) than in this specimen (1551 mm., to 436 mm.).

There are certain scale differences between the cotype and the Turrialba specimen. Thus in the former there are 8 supralabials (seven with one partially divided on one side, the third, fourth, and fifth labials bordering orbit), while in the latter there are eight on both sides, the fourth, fifth and sixth bordering orbit. The cotype has 1-2 preoculars not reaching the frontal; in this they are 1-1 touching frontal on both sides.

Pseustes shropshirei (Barbour and Amaral)

Phrynonax shropshirei Barbour and Amaral, Occ. Papers Boston Soc. Nat. Hist., vol. 5, Sept. 12, 1924, p. 131 (vicinity of Gatun, Canal Zone of Panamá).

Phrynonax poecilonotus shropshirei Amaral, Mem. Inst. Butantan, Tomo 4, 1929, pp. 317-318, fig. 4.

This form was originally characterized as follows:

Rostral slightly wider than deep (8:7), just visible above; internasals two thirds as long as the prefrontals (4:6); frontal as long as wide, as long as its distance from end of snout, a little shorter than parietals (10:12); loreal longer than deep; one preocular touching frontal; 2 postoculars; temporals 2+; seven or eight upper labials, fourth and fifth or fourth, fifth and sixth entering orbit, the eighth much the longest; seven to eight lower labials border first chinshields which are much shorter than the posterior (10:17); scales in 25 rows (21-24-25-24-21-19-17-15), the median rows feebly keeled; ventrals 211, obtusely angulate laterally; anal single; subcaudals 116+, divided.

Blackish brown above, irregularly barred with yellow; dorsal scales either entirely black or black-edged; head dark brown above, a wide border on lip yellow, the labials blackish on their upper edges; lower surfaces yellowish gradually changing to pure black posteriorly, including tail; anterior ventrals with dark outer edges. Total length 1630 mm.; tail 430 mm. (Data from type description.)

A specimen, R. C. T. 682 ♀, Turrialba, is referred to this species. It agrees in all essential detail. The head and neck, for 6-8 inches, are coal black save outer two scale rows which have some white; beyond this the pattern of transverse marks consisting of black-edged yellowish scales continues to tail; ventral surface of posterior part of body and tail nearly uniform black; ventrals 214; subcaudals 116+ (tip missing). Scale rows 21-23-25-13(15); supralabials 8-8; infralabials 11-11, seven touching the first chinshield. Total length 1714 mm.; tail 469 + mm. (tip missing).

Since the specimen of *poecilonotus chrysobronchus* was obtained at this locality (within three miles), I would suspect that the two are worthy of specific rank.

Genus CHIRONIUS Fitzinger

Chironius Fitzinger, Neue Classification der Reptilien . . . , 1826, p. 31.

Genotype: *Coluber carinatus* Linnaeus.

Three species of this genus occur in Costa Rica. They may be distinguished by the following key.

KEY TO THE COSTA RICAN SPECIES OF CHIRONIUS

1. Dorsal scales smooth; three labials enter orbit; scales 10-8 ..... *melas*
   Dorsal scales keeled; two or three labials enter orbit 2
2. Scale formula, 12-8; two labials enter orbit; (rarely not keeled) ..... *carinatus*
   Scale formula, 10-8, three labials enter orbit ..... *grandisquamis*

Chironius carinatus (Linnaeus)

Coluber carinatus Linnaeus, Museum Adolphi Friderici Regis, I, 1754, p. 31; and Systema Naturae, vol. 1, 1766, p. 384.

Chironius carinatus Fitzinger, Neue Classification der Reptilien . . . , 1826, p. 60; Dunn and Bailey, Bull. Mus. Comp. Zool. Harvard Coll., vol. 86, 1939, p. 18 (Cana, Panamá).

Specimens of *Chironius carinatus* may be identified as to genus by the large scales in even number of rows, varying from 12 rows anteriorly to 8 on the posterior half of the body. A second easily observed character is the high dorsal ridge on the body, flat on top, covered by two scale rows, each scale bearing a sharp keel. Anteriorly the scales tend to form diagonal rows, but posteriorly this is not the case.

Our collections contain two specimens caught along the Reventazón River on the farm of the Inter-American Institute of Agriculture, two kilometers southwest of Turrialba, and one at Isla Bonita on Volcán Poás.

The following scale characters obtain in M. N. H. No. 25745, Turrialba: rostral visible above; frontal longer than its distance from the snout, one-fourth longer than wide; parietals short, about one-fourth times longer than wide, their length equal to that of the frontal or slightly longer; nasal divided, the anterior part larger; loreal low, much longer than high; one very large supraocular not reaching the frontal; two postoculars; temporals 1+2; supralabials 9-9, the fifth and sixth entering orbit; infralabials 11-11, five touching anterior chinshields, which are about same length as posterior pair; scale rows 12-12-8; ventrals 147, subcaudals 133.

A specimen in the U. S. National Museum collected by George K. Cherrie in "Costa Rica" has 153 ventrals and 136+ subcaudals; scale rows 12-12-8, the keels not strongly evident (the outer epidermis being absent); supralabials 9-9; the fourth, fifth and sixth border orbit (the fourth barely touches); infralabials 10-11, the six anterior touching the first chinshields. Above uniform olive green, the belly

lighter olive; chin, labials and throat, for a short distance, yellowish.

Another specimen (U. S. N. M. No. 14063) has the median scale rows very strongly keeled; scale formula, 12-12-8; ventrals 145, subcaudals 123; anal divided.

A third Costa Rican specimen is uniform olive-green and has the median rows keeled; ventrals 146, subcaudals 138. I failed to record the museum number of this specimen.

Chironius grandisquamis (Peters)

Spilotes grandisquamis Peters, Monatsb. Akad. Wiss. Berlin, 1868, p. 451 (type locality, Costa Rica).

Herpetodryas grandisquamis Cope, Journ. Acad. Nat. Sci. Philadelphia, vol. 8, 1876 (1875), p. 135; Bocourt, Etudes sur les Reptiles; Mission Scientifique au Mexique et dans l'Amérique Centrale, livr. 12, 1890, p. 732, pl. 43, fig. 5.

One very large specimen (No. 703) was obtained at Isla Bonita. In preservative the specimen is coal black above, especially on the latter two thirds of the body and tail (probably olive in life). The lower part of the supralabials, the chin and throat are whitish (probably yellowish in life). The light color of the ventrals begins to be clouded at the 54th ventral, and at the 80th the ventrals have become entirely dark.

This snake may be differentiated readily from *Chironius carinatus* by the scale formula 10-8 (instead of 12-8), and by the fact that three labials, the fourth, fifth and sixth (instead of the fifth and sixth only) enter the orbit and the second pair of chinshields are nearly a half longer than the first pair (instead of being equal or only slightly larger). The two median scale rows are elevated and strongly keeled, and the other scale rows are rather lightly keeled, except the outer which is smooth.

Some of the scale characters of this specimen are: rostral visible above as a narrow line; internasals very large, their length only a little less than that of the prefrontals; frontal distinctly shorter than its distance to the tip of the snout, and at least one-third shorter than the short parietals; length of latter less than their distance from the internasals; nasal not completely divided; loreal not noticeably longer than high; one very large preocular not reaching frontal; two postoculars; temporals, 2-2; supralabials, 9-9, fourth to sixth bordering orbit; infralabials 10-10, five touching the anterior chinshields; ventrals 161; subcaudals 127 +; anal divided. Single pits are present on a few scales on anterior part of body.

Length 2164 + mm., of which the tail is 750 + mm. (probably not more than one or two centimeters missing). The stomach contained a large specimen of *Eleutherodactylus* partially digested.

A specimen in the U. S. National Museum from "Costa Rica" (No. 14061) has 162 ventrals, 128 subcaudals. The yellow color of venter extends to the 75th ventral.

Chironius melas (Cope)

Herpetodryas melas Cope, Proc. Amer. Philos. Soc., vol. 23, 1886, p. 278 (Nicaragua).
Chironius fuscus (part.) Amaral, Mem. Inst. Butantan, Tomo 4, 1929, p. 161 (35).

The characters of this species are as follows:

Scales in ten longitudinal series, all smooth, those of the median row larger than those of the lateral rows and rather smaller than the parietal scales; parietals rather short and wide, openly emarginate behind; nine supralabials, all longer than high, the fourth, fifth and sixth entering orbit; nasals well developed; loreal square; one preocular, two postoculars; temporals 1 + 1 + 1; muzzle rather short; eye large, its diameter equal to its distance from the nostril; infralabials ten, five touching first chinshield; second pair of chinshields longer than first; ventrals 158; anal divided; subcaudals 139. Total length 1210 mm.; tail 470 mm.

Shining black except on the supralabials and anterior or half of venter which are cream; the edges of light ventrals are black; here and there black scales have white edges, especially back of jaw angle, (data from type specimen).

I have examined a Costa Rican specimen classified as this species in the U. S. National Museum collected by C. N. Riotte. It agrees with the type in the characters of squamation save that the anal is single. Ventrals 163; subcaudals 141. The sides of the frontal slightly concave; frontal 1/4 to 1/3 longer than its distance from snout; parietals short, 1/6 longer than the frontal; head dark, the labials cream; snout somewhat lighter than back of head; anteriorly a series of transverse lines formed of brown dots; there are 20 of these in a distance of 5 inches; farther back the dots are larger, the interspaces narrower. The specimen is discolored to the extent that one cannot be certain of the posterior coloration. It may be that this specimen is incorrectly referred here. The anal plate may, however, represent an anomaly.

Genus ELAPHE Fitzinger

Elaphe Fitzinger in Wagler, Descriptiones et icones amphibiorum, pt. 3, 1833, text to, and pl. 27.

Genotype: *Elaphe parreysii = quatuorlineata.*

Two species occur in Costa Rica. These may be distinguished by the following key:

KEY TO THE COSTA RICAN SPECIES OF ELAPHE

Scales 31-35-21; young pale brown with one or two dorsal series of about 50 dark brown black-edged spots, alternating with smaller lateral spots. Adults uniform brown, below yellowish ..... *triaspis*

Scales 27-33-21; a series of large red or chestnut brown spots on each side which may alternate or join to form a zigzag band; below, yellowish, usually with brown spots ..... *flavirufa flavirufa*

Elaphe triaspis (Cope)

Coluber triaspis Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 18, 1866, p. 128 (type locality, Belize = British Honduras).

Elaphe triaspis Amaral, Mem. Inst. Butantan, Tome 4, 1929, p. 158 (33); Smith, Copeia, No. 3, 1941, p. 136.

Rostral about as wide as high, visible from above; internasals much shorter than prefrontals; frontal one and one half times as long as wide, its length equal to its distance from end of snout; loreal present; preocular one, large, reaching frontal or not; two postoculars; temporals 2 + 3, 3 + 3, or 3 + 4; supralabials eight or nine, normally eight, the fourth and fifth bordering eye; infralabials 13, four or five bordering first chinshields, which equal the posterior pair in length; scale formula, 31-35-21, the posterior rows faintly keeled. Ventrals 243-282; anal divided; subcaudals 73-119. Eye relatively small.

Young pale brown above with one or two dorsal series of about 51 large dark brown black-edged spots and an alternating lateral series of smaller spots; two or three dark brown stripes on occiput and neck; two curved dark stripes across snout. Adult uniform brown, lower parts uniform yellowish. Total length more than one meter.

According to Smith, (*loc. cit.*) a specimen from Costa Rica (U.S.N.M. No. 9777), is one of the paratypes of *Coluber mutabilis* Cope. The specimen has 259 ventrals; subcaudals 114; scale formula 29-31-25-21, with low keels on the scales of the posterior part of the body; temporals 4 + 5; supralabials 8-8. The specimen measures 1080 mm. in total length; the tail, 247 mm.

Elaphe flavirufa flavirufa (Cope)

Coluber flavirufus Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 18, 1866 (1867), p. 319 (type locality, Yucatán).

Elaphe flavirufa Viquez, Nuestros Animales venenosas, 1941, p. 65 (Costa Rica).

Elaphe flavirufa flavirufa Smith, Copeia, 1941, no. 3, p. 132, fig. 2.

Rostral broader than deep, just visible above; internasals shorter than prefrontals, frontal one and one half to one and one third times as wide as long, nearly equal to its distance from snout tip, shorter than parietals; loreal present, longer than high; preocular

one, large (may be divided); postoculars two; temporals 2 + 3, 3 + 3, or 3 + 4; eight or nine supralabials, fourth and fifth, or sometimes also sixth, enter orbit; infralabials, 13-13, four or five touching the anterior chinshields; scale formula 27-33-21; the dorsals faintly keeled; ventrals 252-266; subcaudals 102-119; anal divided.

Yellowish or pale brown above, with a dorsal series of about 51 reddish or chestnut-brown black-edged transverse spots which may alternate or be confluent into a zigzag band; a lateral series of spots alternating with the larger dorsal series; two curved bands across snout, and some symmetrical marks on the crown and occiput; two longitudinal bands on the occiput and nape, sometimes confluent in front and behind; lower surface yellowish with or without small brown spots.

Total length, 1220 mm.; tail 260 mm.

I have not examined any Costa Rican specimens of this species.

Genus DRYMARCHON Fitzinger

Drymarchon, Fitzinger, Systema Reptilium, 1943, p. 26.

Genotype: *Coluber corais* Daudin.

Only a single species of this genus of very large snakes is known in Costa Rica.

Drymarchon corais melanurus (Duméril, Bibron and Duméril)

Spilotes melanurus Duméril, Bibron and Duméril, Erpétologie Générale, vol. 7, pt. 1, 1854, pp. 224-225 (type locality, Mexico).

Drymarchon corais melanurus Ruthven, Misc. Publ. Mus. Zool., Univ. Michigan, no. 8, 1922, p. 65.

In Costa Rica this species is second in size to *Constrictor constrictor imperator*. The specimen at hand, M. N. H. No. 25755, from 2½ km. west of Turrialba, measures 2634 mm. (8 ft. 8 in.); tail 410 mm.

Rostral visible above; internasals large, their common suture two thirds that of prefrontals; frontal small, as broad as long, about equal to its distance to middle of the internasals or a little longer; supraoculars two thirds width of frontal and about one sixth longer; parietals one third longer than wide, their length equal to their distance from the middle of the internasals; nostril large between two nasals, the posterior much the larger; loreal a little longer than high; preocular large, much higher than wide, widely separated from the frontal; postoculars two; temporals $2 + \frac{1}{2}$; supralabials 8-8, the fourth and fifth border eye, the fifth and seventh touch

above the smaller triangular sixth; infralabials 8-8, four touch the first chinshields, which are larger and longer than second pair.

Color above drab brown, many scales having cream edges; some dim grayish markings on outer part of many of the scales but not bordering the edges. Beginning about midway of the body, the median rows develop small gray-black flecks; these grow more numerous posteriorly so that latter fifth of body and tail shining black; on sides one can discern an indefinite black coloration on skin between scales, occasionally also visible on edges of some scales. Head above uniformly colored like anterior part of body, but the fourth to seventh supralabials with a black posterior border; there is a pair of diagonal stripes on neck, joining a black ventral scale; ventral surface flesh color, the outer posterior edges of ventrals bearing a narrow black stripe or spot, and on outer edges (about 1/7 of width) the body color encroaches on each ventral; this is sharply delineated from ventral coloration. After middle of body is passed ventrals become gradually darker until the latter fifth of body is shining coal black.

I have observed a Costa Rican specimen in the U. S. National Museum (No. 61947), without specific locality.

Genus MASTICOPHIS Baird and Girard

Masticophis Baird and Girard, Catalogue of North American Reptiles . . . , 1853, p. 98.

Genotype: *Masticophis ornatus* Baird and Girard.

One species is known from Costa Rica.

Masticophis mentovarius (Duméril, Bibron and Duméril)

Coryphodon mentovarius Dumèril, Bibron and Duméril, Erpétologie Générale . . . , 1854, vol. 7, pt. 1, p. 187 (type locality, between Cobân and Clusec, Guatemala).

Masticophis mentovarius Ortenburger, Occ. Papers Mus. Zool., Univ. Michigan, no. 139, p. 2; Dunn, Copeia, 1933, p. 214 (La Palma, Costa Rica); Smith, Copeia, 1942, no. 2, pp. 85-88.

Coluber mentovarius Brongersma, Studies on the Fauna of Curaçao, Arubu, Bonaire and the Venezuelan Islands, vol. 2, 1940, pp. 6-7.

A specimen purporting to be this species has been reported from La Palma, Costa Rica. Smith believes it is confined to the drier western part of Central America.

Smith (*loc. cit.*), has pointed out that the form occurring in Venezuela and Colombia is to be regarded as subspecifically distinct from the northern one, on the basis of juvenile coloration, and revives Peter's name *suborbitalis*. Until juvenile specimens are collected in Costa Rica, one cannot be certain whether the northern *mentovarius mentovarius*, or *mentovarius suborbitalis* is the form that occurs.

The species may be distinguished by the following synopsis: scale formula 17-15-13; ventrals 189-208; subcaudals 111-119; seven supralabials (the normal fourth and fifth labials of the other species are fused below eye to bring about the reduction to seven); infralabials ten, rarely eleven; two preoculars, lower very small; two postoculars, temporals 2 + 2 + 2 usually; anterior chinshields wider and shorter than posterior; loreal a little longer than high.

Dark brown to brown-gray; sides of neck may show some trace of longitudinal stripes on rows one and two. Posteriorly the body becomes lighter, and in some specimens almost every scale has one or more elongate small gray marks; head uniform dark brown, with dark markings on the side of the head; infralabials immaculate or covered with large blotches; anterior belly marks vary from small gray dots to large black blotches; posteriorly the belly is usually immaculate cream.

Genus LEPTODRYMUS Amaral

Leptodrymus Amaral, Bull. Antiv. Inst. Amer., vol. 1, 1927, p. 29.

Genotype: *Salvadora grahamiae* Baird and Girard.

A single species is known from Costa Rica. The genus ranges from southern United States to Costa Rica.

Leptodrymus pulcherrimus (Cope)

Masticophis pulcherrimus Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 26, 1874, p. 65 (western side of Central America).

Leptodrymus pulcherrimus Bogert, Amer. Mus. Novitates, no. 1352, 1947, pp. 1-14.

Rostral broadly visible above; internasals about as long as wide, as long as prefrontals; frontal longer than its distance from the snout tip, shorter than the parietals; nasal divided, the nostril chiefly in the posterior part; loreal twice as long as high; one large preocular, not reaching frontal; three postoculars, subequal; temporals 2 + 1 + 1 + 2 (2 + 1 + 2 + 2); supralabials 9-10, the fifth and sixth entering the orbit; infralabials 10-11, five (or six) bordering first chinshields, which are a little shorter than second pair.

Scale formula: 17-17-15, with paired pits; scales of median dorsal row smallest; ventrals 203, subcaudals 126 + (tip missing).

Top of head olive; ground color gray on sides; two black stripes begin on snout, pass through eye and on body to tail; chin and labials cream; venter cream.

The ventrals throughout the known range of the species vary from 199 to 210; subcaudals vary from 148 to 152.

I have examined a Costa Rican specimen in the U. S. National Museum. Bogert, *loc. cit.*, lists a specimen from Pacaca, Costa Rica. These records are the southernmost known for the species.

Genus LEIMADOPHIS Fitzinger

Leimadophis Fitzinger, Systema Reptilium, 1843, p. 26.

Genotype: *Natrix almadensis* Wagler.

One species occurs in Costa Rica.

Leimadophis taeniurus juvenalis Dunn

Leimadophis taeniurus juvenalis Dunn, Copeia, 1937, no. 4, p. 213 (type locality, San José, Costa Rica).

? *Liophis (Rhadinaea) cobella* Wettstein, Sitzber. Akad. Wiss. Wien, vol. 143, 1934, p. 341.

This is a common snake in Costa Rica. Six specimens were taken, the series including both young and adult. The snake when annoyed flattens its body greatly, thus spreading the scales and exposing the bright red color on the skin and scale edges between the black bands. The red color is largely concealed when the body is not distended. Sometimes the snakes rear the head in cobralike fashion and attack menacingly.

The general coloration of the snake is black dorsally. Thirty-five bands present on the body, separated by lighter bands, in which the skin between the scales, as well as the concealed edges of most of the scales, is red; head black, labials yellow; below, chin and anterior part of neck creamy white, the cream washed with orange anteriorly, but posteriorly venter deep coral to orange red; somewhat triangular black spots on outer sides of ventrals (sometimes the black spots alternate). These are absent on anterior part of neck. First row of scales deep olive green anteriorly, grayish posteriorly on latter three fourths of body.

There are 23 maxillary teeth, followed after an interspace by two enlarged fangs. One of the specimens, No. 699, contained in its stomach a partly digested *Eleutherodactylus* of an undetermined species.

Dunn, *loc. cit.*, has identified Wettstein's specimens of *Liophis (Rhadinaea) cobella* from Bebedero and Irazú as probably belonging in this species.

TABLE OF DATA ON LEIMADOPHIS TAENIURUS JUVENALIS

Museum	No.	Sex	Ventrals	Subcaudals	Supralabials	Infralabials	Scale formula
R.C.T.	651	(yg.)	140½	54	8–8	10–10	17–17–15
R.C.T.	699	♀	145	62	8–8	10–10	17–17–15
R.C.T.	729	(yg.)	146	55	8–8	10–10	17–17–15
M.N.H.	25750	♂	142	52	8–8	10–10	17–17–15
M.N.H.	25751	♀	146½	54	8–9	10–10	17–17–15
M.N.H.	25752	♂	145	53	8–8	10–10	17–17–15

Genus LAMPROPELTIS Fitzinger

Lampropeltis Fitzinger, Systema Reptilium, 1843, p. 25.

Genotype: *Herpetodryas getulus* Schlegel.

There is a possibility that three separable forms occur in Costa Rica. These are *Lampropeltis doliata polyzona, L. d. micropholis* and *L. d. gaigae*. The first is said to intergrade with the second, and if true, both forms may likewise occur in typical state. The status of the third may be questioned since the young seemingly cannot be told certainly from the young of the other subspecies. The adults, which often reach a length of six feet, may become black, losing most, if not all, of the color markings.

KEY TO THE SUBSPECIES OF LAMPROPELTIS DOLIATA *

1. Adults black; dorsal scale rows usually 19, rarely 21 ..... *gaigae*
   Adults ringed, not black; dorsal scales rare'y 19, almost always 21 or 23 2
2. Dorsal scale rows 21 or 23 in both sexes; caudals average 48 or more; usually two anterior temporals; light areas between black rings narrower; snout black with a light cross-bar ..... *polyzona*
   Dorsal scales rarely 19, usually 21 in males, never 23 in males, 21 to 23 in females; caudals average 46 or less, females average under 44; usually one anterior temporal; light areas broader; snout spotted ..... *micropholis*

Lampropeltis doliata polyzona Cope

Lampropeltis polyzona Cope, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 258 (Quatupe, near Jalapa, Mexico); Blanchard, U. S. Nat. Mus. Bull., no. 114, 1921, pp. 139-149.

Lampropeltis triangulum polyzona Dunn, Occ. Papers Mus. Zool., Univ. Michigan, no. 353, Apr. 28, 1937, pp. 1-11.

This form is a black, yellow (cream) and red snake belonging to the harmless "coralillos." The bands are arranged in triads, black-yellow-black separated by interspaces of red (usually black dotted); the number of these triads varies tremendously in number, from 17 to 37 as understood by Blanchard, *loc. cit.* (average of 25 *fide* Stuart, Occ. Papers Mus. Zool., Univ. Michigan, no. 309, March, 1935, pp. 1-6). The head is black to near the end of the parietals and there is usually a yellow band across the snout. The anterior temporals are normally 2-2. A curving yellow band is continuous across back of head covering back part of parietals and then passing under chin. The ventrals of southern (Nicaraguan) specimens vary between 223-231 ♂ and 228-234 ♀. (Data largely from Dunn, 1937.)

* Data from Dunn, Occ. Papers Mus. Zool., Univ. Michigan, No. 353, Apr. 28, 1937, pp. 1-11.

[*Lampropeltis doliata gaigae* Dunn]

Lampropeltis triangulum gaigae Dunn, Occ. Papers Mus. Zool., Univ. Michigan, no. 353, Apr. 28, 1937, pp. 9-11 (Boquete, Chiriquí, Panamá; also reported from Volcán Barba, Monte Redondo, Volcán Irazú and Paloma. The subspecies name is probably intended for *gaigeae* and presumably intended to honor Mrs. Helen Thompson Gaige, since the type is said to have been collected by "the Gaiges").

This color form has been named from certain Panamanian and Costa Rican specimens, all coming from considerable elevation (3900-6500 ft.). The young are brilliantly colored like lowland specimens, but the adults are black. I suspect it would be impossible to separate the forms save on fully adult specimens. Presumably the number 19 for scale rows is more common than 21 or 23. From the data offered, the scale characters have the same variations as the presumed intergrades of *micropholis* and *polyzona*. It is conceivable that one or both forms listed as belonging to *micropholis* may belong here.

Lampropeltis doliata micropholis Cope

Plate IX

Lampropeltis micropholis Cope, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 257 (Panamá).
Coronella doliata formosa (*part.*) Jan. Iconographie Générale des Ophidiens, livr. 14, Dec. 1861, pl. 4, "fig. B*" (composite, but fig. B chosen as type. See following reference).
Lampropeltis micropholis Blanchard, U. S. Nat. Mus. Bull. No. 114, 1921, pp. 149-152.
Lampropeltis triangulum micropholis Dunn, Occ. Papers Mus. Zool., Univ. Michigan, no. 353, Apr. 28, 1937, pp. 1-11.

Dunn, *loc. cit.*, has suggested that the form *Lampropeltis doliata micropholis* intergrades with *L. d. polyzona* to the north. Of the two specimens of *Lampropeltis* available in the collection, one R.C.T. No. 1026 was taken from the Pacific slope of Cerro de la Muerte at an elevation of approximately 5500 ft., and the other from Isla Bonita (M.N.H. No. 25164) on the eastern slope of Volcán Poás, at an elevation of approximately 5500 ft.

The general characters of these specimens are as follows (where data vary, the first is No. 1026, the second, No. 25164): rostral large, the length of the part visible above greater than length of internasals; common suture of latter scales as long as that of prefrontals; frontal very broad, equal or a fifth larger than the distance to tip of snout; the parietals equal to their distance from middle of internasals; nasal divided; loreal trapezoidal, longer than high; a large preocular separated from frontal; two postoculars; temporals 1+2 (1+3), but with a tiny intercalated scale bordering the parietal on left side; supralabials 7-7, third and fourth bordering orbit; infralabials 9-9, four touching anterior chinshields, which are nearly

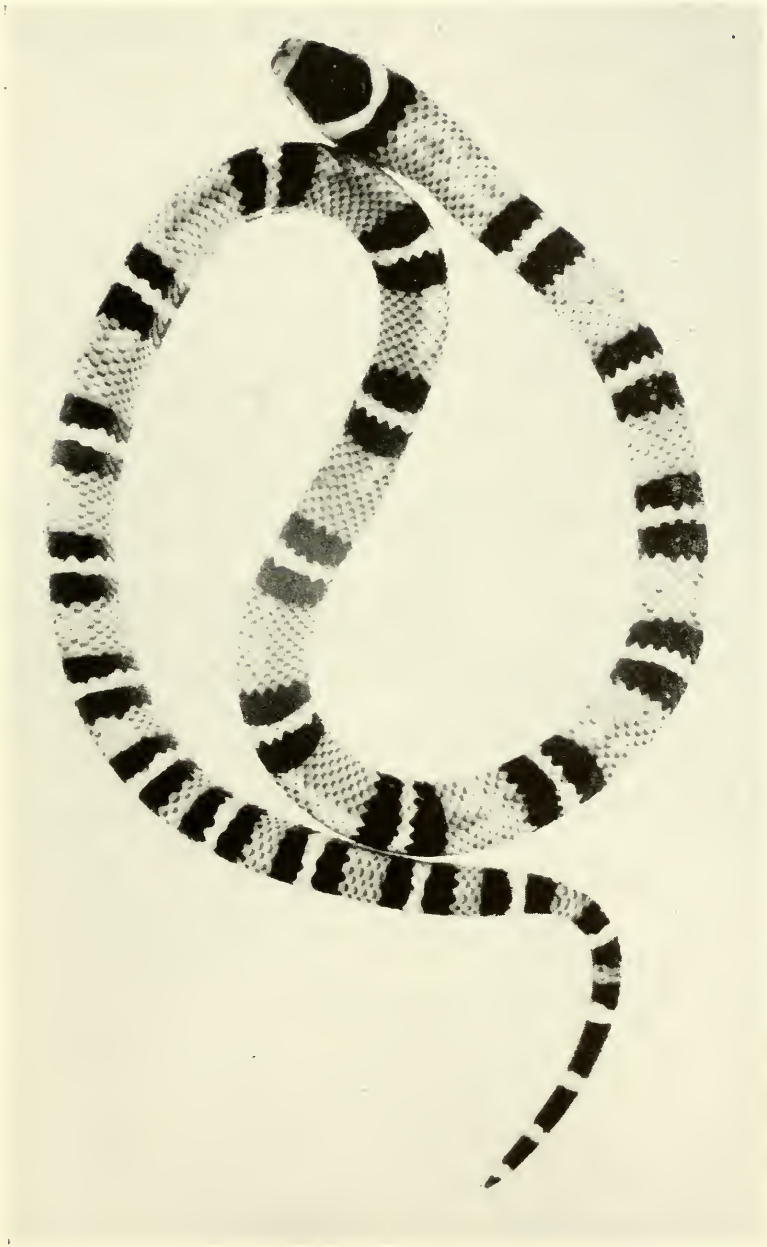


PLATE IX. *Lampropeltis doliata micropholis* Cope, RCT No. 1026, Pacific slope of the Cerro de la Muerte, Costa Rica; approximate elevation 5500 feet. About natural size.

double area of second pair. Scale rows 21-19-19-15(14), (21-19-19-17), all smooth with widely separated pits; ventrals 231, subcaudals 48 (230, 51).

Color pattern of No. 1026 is shown in Plate No. 9. The triads (black-yellow-black) are 19, separated by red areas of greater length than the triad except for the last five; head black with a narrow light band across snout (on prefrontals and internasals) and a narrow curved light band on back of head, bordered by a similar black band and involving back ends of parietals; the light band curving forward to near eye and across throat and chin where it widens; one postocular with a white area, as is true of the preocular; first four supralabials black or with a black area; five anterior infralabials same; seven white rings on tail, only first two or three forming triads; red absent on posterior part of tail; red scales with dark spots indicated; venter with red and white areas immaculate.

In No. 25164 the curving band is indicated by a cream spot on back ends of parietals and adjoining body scales, but black of head joined, by a broad bridge, with the curving nuchal black band; the whitish area on the fifth and sixth supralabials, and those across chin, have some darker markings. There are 17 triads, the intervening red areas always greater than length of combined parts of triads; ventral red and yellow areas with much black; dorsal scales of red bands with discrete black spots on anterior tip of scales; on white (yellow) bands, spots are larger and irregular, almost obscuring the band.

I have referred these forms to *micropholis* on the basis of the reduced number of triads, the single anterior temporal and the wide bands of red.

Genus PLIOCERCUS Cope

Pliocercus Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 12, 1860, p. 253.

Genotype: *Pliocercus elapoides* Cope.

One species is recorded from Costa Rica.

KEY TO SPECIES OF PLIOCERCUS IN COSTA RICA

Rings on body fewer, 14, on tail 8; ventrals 127, subcaudals 120, 3 preoculars ..... *dimidiatus*

Rings on body more numerous, 22½, on tail approximately 11; ventrals 137, subcaudals (?); 2 preoculars ..... *annellatus*

Pliocercus dimidiatus Cope

Pliocercus dimidiatus Cope, Proc. Acad. Nat. Sci. Philadelphia, 1865, p. 190 (type locality, Arriba, Costa Rica) and Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol 8, 1876 (1875), p. 138; U. S. Nat. Mus. Bull. no. 32, 1887, p. 79.

Elapochrus dimidiatus Günther, Biologia Centrali-Americana, Oct. 1893, p. 107 (Costa Rica).

Urotheca elapoides (*part.*) Boulenger, Catalogue of the Snakes of the British Museum, 2nd ed., 1894, pp. 182-183; Werner, Zool. Jahrb., Bd. 57, 1929, p. 122.
Urotheca dimidiata Gaige, Hartweg, and Stuart, Occ. Papers Mus. Zool., Univ. Michigan, no. 357, 1937, p. 16.
Pliocercus euryzona dimidiatus Dunn and Bailey, Bull. Mus. Comp. Zool. Harvard Coll., vol. 86, no. 1, 1939, pp. 11-12.

The type of this black and red banded snake has the following characters: Top of rostral round, curved back on upper surface; internasals small, about one half the length of the prefrontals; lateral borders on the frontal nearly parallel, the scale pentagonal; parietals large; temporals 1 + 1; loreal nearly a rhomb; three preoculars, the lower cut from a labial; two postoculars; supralabials nine, the fifth and sixth enter orbit; nine infralabials; chinshields equal; scales in 17-17 rows; ventrals 127, subcaudals 120.

Red above crossed by 14 black rings on body and eight and part of another on tail; these separated by nearly equal spaces below, and rather narrower spaces above (3½ scales); a black nuchal band 8 scales wide involving posterior part of the parietals; a red band across back of head; anterior part of head black, the first two labials whitish.

I have examined the type specimen.

[*Urotheca lateristriga* (Berthold), now placed in the genus *Rhadinaea* has been reported from Costa Rica but the reports were possibly based on species other than *lateristriga*.]

Pliocercus annellatus sp. nov.

Plate X, text fig. 4

Type—U. K. M. N. H. No. 25370; Morehead Finca, five miles southwest of Turrialba, Costa Rica. E. H. Taylor, collector; 1947.

Diagnosis—Related to *Pliocercus dimidiatus* but having 22½ body bands instead of 14, two instead of three preoculars; eight supralabials, the fourth and fifth entering orbit, instead of nine with the fifth and sixth entering orbit.

Description of type specimen—Rostral low, visible above as little more than a line; internasals small, wider than long, their common suture half that between prefrontals; latter scales longer than wide, with a distinct rounded canthus, the snout rather narrowed; frontal about one-fourth longer than wide, its length equal to its distance from the rostral, the anterior border straight, the sides almost parallel; parietals longer than frontal, their length a little less than distance to middle of internasals; nasal divided; loreal somewhat trapezoidal; two preoculars, the upper large, but not touching

frontal, the lower small, wedged in between the third and fourth supralabials; two subequal postoculars; supraoculars slender; temporals 1 + 1 + 2 (1 + 2 + 2); supralabials 8-8, the fourth and fifth border orbit; 9-9 infralabials, five touching the first pair of chinshields, which are as long or slightly longer than second pair; scales smooth, lacking apical pits, in 17-17-17 rows; ventrals 137, the first separated from chinshields by one pair of scales; subcaudals 73 + with a portion of the tail missing.

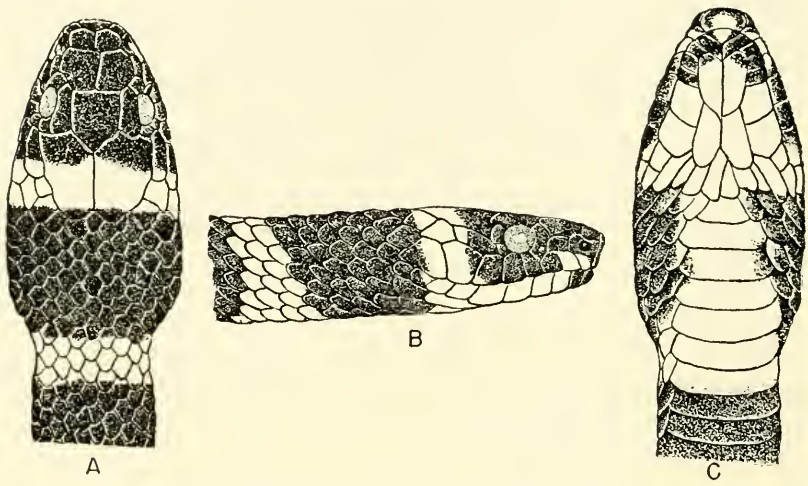


FIG. 4. *Pliocercus annellatus sp. nov.* Type. MNH No. 25370. Morehead Finca, 5 miles SW Turrialba, Costa Rica. A. Head, dorsal view; B, Head, lateral view; C, Head, ventral view.

Dorsally banded red and black; the black bands 22½ in number (including nuchal), five or six scale-lengths long, the red bands two or two and a half scales. Color white or cream-white on the neck and chin, gradually becoming tomato-red in the middle and posterior parts of body; the black bands occupy three or four ventrals, the red two or three; tail partly missing but 6½ bands present (three or four more bands probably present on the part missing); caudal black bands a little longer than those on body; head deep black to level of middle of parietals except for a white spot on first two supralabials; white band crosses back of head not reaching the posterior tip of parietals; chin and lower lip cream save for first four infralabials, anterior tips of first chinshields, and parts of the mental, which are black; the nuchal black band interrupted mesially.

Measurements in mm.: Total length, part of tail missing, 699; snout to vent 464; length of head 23; width of head, 14.

Remarks: The other form of this genus that might be expected to occur in costa Rica is *Pliocercus euryzonus euryzonus*. That form may be readily separated from *annellatus* by the pattern of the black bands which on the dorsal surface leaves bands of red only one, or more frequently, only one-half scale length wide; the band across occiput usually is of the same width. The type description of this form states that the snout is broadened at the muzzle; the temporals

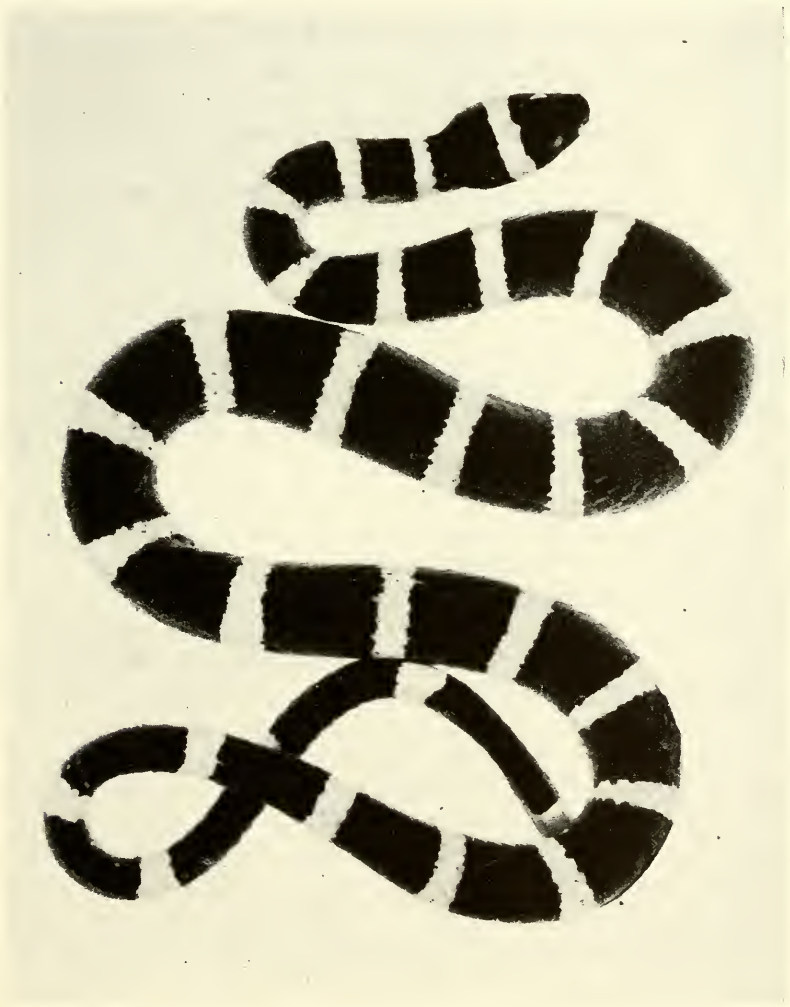


PLATE X. *Pliocercus annellatus sp. nov.*, MNH No. 25370, Morehead Finca, 5 miles SW Turrialba, Costa Rica; total length, 699 mm.

are said to be "one large and four small," the supralabials are nine, the fifth and sixth entering orbit; 10 infralabials present; the number of bands on body is 19; on tail, 11.

It would appear that *Pliocercus annellatus* represents a species intermediate between *dimidiatus* and *euryzonus*. It is conceivable that it does bear a subspecific relationship to one or the other of the two, but this is surmise.

Genus Liophis Wagler

Liophis Wagler, Natürliches System der Amphibien, 1830, p. 187.

Genotype: *Coluber cobella* Linnaeus.

A single species of this genus has been reported in Costa Rica. The genus is South American and there may be some doubt that the records here presented are authentic.

Liophis cobella (Linnaeus)

Coluber cobella Linnaeus, Museum Adolphi Friderici regis, 1754, p. 24, and Systema Naturae, vol. 1, 1766, p. 378 (type locality, Asia [in error]).

Rhadinaea cobella Boulenger, Catalogue of the Snakes in the British Museum, vol. 2, 1894, pp. 166-167. (South American localities.)

Liophis cobella Peters, Monatsb. Akad. Wiss. Berlin, 1859, p. 276 (Costa Rica).

? *Liophis* (= *Rhadinaea*) *cobella* Wettstein, Sitz. Akad. Wiss. Wien, Math.-naturw. Klasse, Abt. 1, Band 143, Heft ½, 1934, p. 34 (Costa Rica); Dunn, Copeia, 1937, no. 4, p. 213.

The reference by Wettstein (*loc. cit.*) of two specimens, one adult from Volcán Irazú, 2400 m., and a half grown one from Bebedero, to the species *Liophis (Rhadinaea) cobella*, is I believe the second record of the species for Costa Rica. That of Peters, *loc. cit.*, is the first. Wettstein states that he has compared the specimens with numerous specimens of *cobella* in the Vienna Museum.

The specimens are bright gray brown, with bands of black. The outer scale edges bear light streaks especially on the anterior part of the body. The venter is bright orange (perhaps red in life); the ventrals are 149-147; the subcaudals 58.

Boulenger, *op. cit.*, gives the following characters: rostral broader than deep, visible from above; internasal as long as broad or a little broader, approximately as long as the prefronals; frontal once and a half to once and three fourths as long as broad, about as long as its distance from end of snout, a little shorter than parietals; loreal as long as high or a little longer; preocular one, postoculars two; temporals 1+2; supralabials eight, fourth and fifth border eye; five infralabials touch first chinshields which are as long as or a little longer than second pair. Scales in 17 rows. Ventrals 143-163; anal divided; subcaudals 45-57. Tail 4⅔ to 6 times in total length.

Brown or blackish above with whitish lines and crossbands; belly yellow (coral red in life) with transverse black spots or crossbands, always more or less marked in young, which have a blackish nuchal collar edged with whitish, and a pair of whitish dots on parietal shields; upper labials yellowish.

Genus RHADINAEA Cope

Ithadinaea Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 15, 1863, p. 100.

Genotype: *Taeniophis vermiculaticeps* Cope.

This genus of small terrestrial snakes is represented by a rather extraordinary number of species, no less than nine having been reported. A species, *Rhadinaea güntheri* Dunn,* a new name for *Tachymenis decipiens* Günther,† is treated in the genus *Coniophanes*, a genus similar to *Rhadinaea* in many ways, but having grooved posterior teeth. I suspect that the name should be suppressed since *Tachymenis decipiens* and *Rhadinaea decipiens* are probably not congeneric. If not a member of the genus *Coniophanes*, it might well be treated under a generic name of its own. References of *Rhadinaea lateristrigata* for Costa Rica are seemingly based on other species.

The genus *Rhadinaea* has recently undergone a partial revision by Dr. J. Bailey (Occ. Papers Mus. Zool., Univ. Michigan, No. 412, 1940).

SYNOPSIS OF COSTA RICAN SPECIES OF RHADINAEA

1. Scales in 19 rows; eight supralabials, the 4th and 5th entering the eye; one preocular; ventrals 164-169; subcaudals 60-78; dark brown with six longitudinal yellow or cream lines; belly yellowish with black dots on ends of ventrals. . *serperastra*
   Scales in 17 rows 2
2. No narrow discrete continuous light lines on sides of body (discrete line may be present on neck then replaced merely by indefinite dim lighter lines) 3
   One or two narrow discrete light lines on side of body 6
3. Six or seven supralabials, 3rd and 4th enter eye; nasal single; tail not more than one fourth of total length; one preocular, two postoculars; the two pairs of chinshields of about equal length; ventrals 152, subcaudals 46; dark brown above, with a narrow black vertebral stripe; two lateral paler stripes; a black stripe along the ends of the ventrals; labials black bordered; belly yellow, with black crescents on front of each ventral suture; a black line under tail ..... *calligaster*
   Eight supralabials, 4th and 5th enter eye 4
4. No continuous line passing through eye and to snout tip; length of tail more than one third of total length; two preoculars (rarely one); ventrals 117-137; subcaudals 90-120; anterior chinshields shorter than posterior; a slightly darker median stripe, black edged, about three scales wide; a lateral black-edged light yellow stripe, cream anteriorly, on 4th or 4th and 5th rows; lower sides darker forming a broad dark stripe; ventrals more or less black-spotted on ends; a black-edged stripe on parietal and an ocellus on side of neck ..... *decorata decorata*
   Dark lines on head and body continuous, passing through eye 5

* Copeia, 1938, no. 4, p. 198.

† Biologia Centrali-Americana, Mar. 1895, p. 163, pl. 53, fig. A.

5. Lower surface of body pinkish, the ventrals finely sprinkled all over with blackish; one preocular, two postoculars; anterior chinshields shorter than posterior; ventrals 132, subcaudals 66; reddish brown above, a black lateral line between 4th and 5th scale rows, edged with yellow on anterior part of body; this line widens on neck and head passing through eye, joining its fellow on end of snout; upper lip white; length, 430 mm.; tail, 140 mm. ..... *pulveriventris*

Lower surface of body yellowish white, the ends of the ventrals bearing deep brown dots; one preocular, two postoculars; anterior chinshields shorter than posterior; ventrals 117, subcaudals 79; yellow-brown above with two deep brown dorsal streaks, separated by width of one scale, diverging on neck and extending to the outer posterior angle of supraocular shield; another dark streak on each side of head and body passing through eye; head brown vermiculated with yellowish; total length 330, tail 115 ..... *vermiculaticeps*

6. Two discrete lateral light lines 7

One discrete light lateral line (may be dim before shedding); subcaudals less than 70; one preocular, two postoculars; temporals 1 + 1; eight supralabials, fourth and fifth entering eye; ventrals 133, subcaudals 50; total length 335 mm.; tail in total length 3⅗ times; scales of outer row with gray tips forming an indistinct lateral line. Black above, the lower lateral scale rows a shade of rufous; head black-brown; labials yellow bordered above by blackish; below yellow, each ventral with black ends ..... *pachyura pachyura*

7. Two narrow light lateral lines on sides, the lower occupying the middle of first scale row, the upper, the middle of the fifth; tail three fourths of body length; head narrow, elongate; ventrals 131-151, subcaudals 113; supralabials eight, fourth and fifth enter orbit; one preocular (rarely a "presubocular"); one or two postoculars; temporals 1 + 1 + 2; above brownish black, lower parts yellow with the ends of the ventrals blackish; markings in females fainter; an occipital light band *pachyura decipiens*

Blackish dorsally, on belly immaculate red; a black line on edge of ventrals and outer edge of first scale row from throat to tail; immediately above this, a white line from throat on middle of row one to end of tail; a white line on fifth scale row; light ocellae on outer corner of parietals, a larger one behind temporals joining lateral line; total length 440 mm., tail 188; seven or eight supralabials; ventrals 137-143, subcaudals 96-112; temporals 1 + 1; one preocular, two postoculars (one "presubocular" usually present), 3rd and 4th or 4th and 5th labials enter orbit; no occipital light ring ..... *persimilis*

Rhadinaea serperastra Cope

Rhadinaea serperastra Cope, Proc. Acad. Nat. Sci. Philadelphia, 1871, p. 212 (type locality, Costa Rica); Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875), p. 140.

Scales in 19 rows, smooth, lacking pits; temporals 1+2+3; nasal divided, the posterior part larger; supralabials eight, the fourth and fifth border eye; loreal square; preocular one; postoculars two; supralabials eight; chinshields subequal in length; ventrals 164; subcaudals 78; anal divided. Maxillary teeth equal.

Dark brown with six longitudinal yellow or white lines of which the first and second are brightest; a white line on each side produced by a series of dark spots on ends of ventrals; labials black with yellow spots; head dark brown above with a pale shade across frontal, and two [spots?] just behind the parietals; chin and belly yellowish (after Cope).

A specimen in Harvard M.C.Z. (No. 28069) is from San José, Costa Rica. There are present 170 ventrals and 65 subcaudals.

Other characters are very similar to those of the type. There is a whitish line from eye to near jaw angle. The arrangement of the lines is as follows: a median dark line; three scale rows on each side of middle, each with a dim darker line; a discrete white line on the fifth and sixth rows; a broader lateral black stripe on third, fourth and fifth rows with a fine white line through the middle; light lines on first, second and third rows, that on first scale row bordered above and below by darker lines; each labial has a white spot.

Rhadinaea calligaster (Cope)

Contia calligaster Cope, Journ. Acad. Nat. Sci. Philadelphia, vol. 8, 1876 (1875), p. 146 (type locality, Pico Blanco, southern Costa Rica).

Scales acuminate in 17 rows, smooth, lacking apical pits; supralabials seven, third and fourth border the orbit; nasal single; loreal subquadrate; preocular one; postoculars two; temporals $1 + 1 + 2$ $(1 + 2 + 2)$; infralabials eight, fourth and fifth largest, the first pair barely in contact behind mental; ventrals 152, anal divided, subcaudals 46; chinshields equal. Maxillary teeth gradually increasing in length to the posterior.

Color above dark brown with a narrow vertebral black band; two lateral paler bands, the lower on the first and second scale rows, the upper on the fourth and fifth, the space between black. A black band along the edge of ventrals; belly yellow, each ventral with a black crescent or with a black base; labials black-bordered.

Known from Pico Blanco, Costa Rica; the exact elevation on the mountain unknown (5000-7000 ft).

The types (U.S.N.M. Nos. 30606-30607) at the present time are in a poor state. Another specimen in the U. S. National Museum (No. 38335) has 147 ventrals, 60 subcaudals. The general color is violet-brown.

Rhadinaea decorata decorata (Günther)

Plate XI

Coronella decorata Günther, Catalogue of the Colubrine Snakes in the Collection of the British Museum, 1858, pp. 35-36 (type locality, "Mexico").

Rhadinaea decorata Cope, Proc. Amer. Philos. Soc., vol. 22, 1885, p. 381.

Rhadinaea decorata decorata Bailey, Occ. Papers Mus. Zool. Univ. Michigan No. 412, May 6, 1940, pp. 7-8, plate 2, fig. 5 (Costa Rican specimen).

A specimen of this species was captured in the mountains one mile west of La Suiza at about 2400 ft. elev. It was found coiled

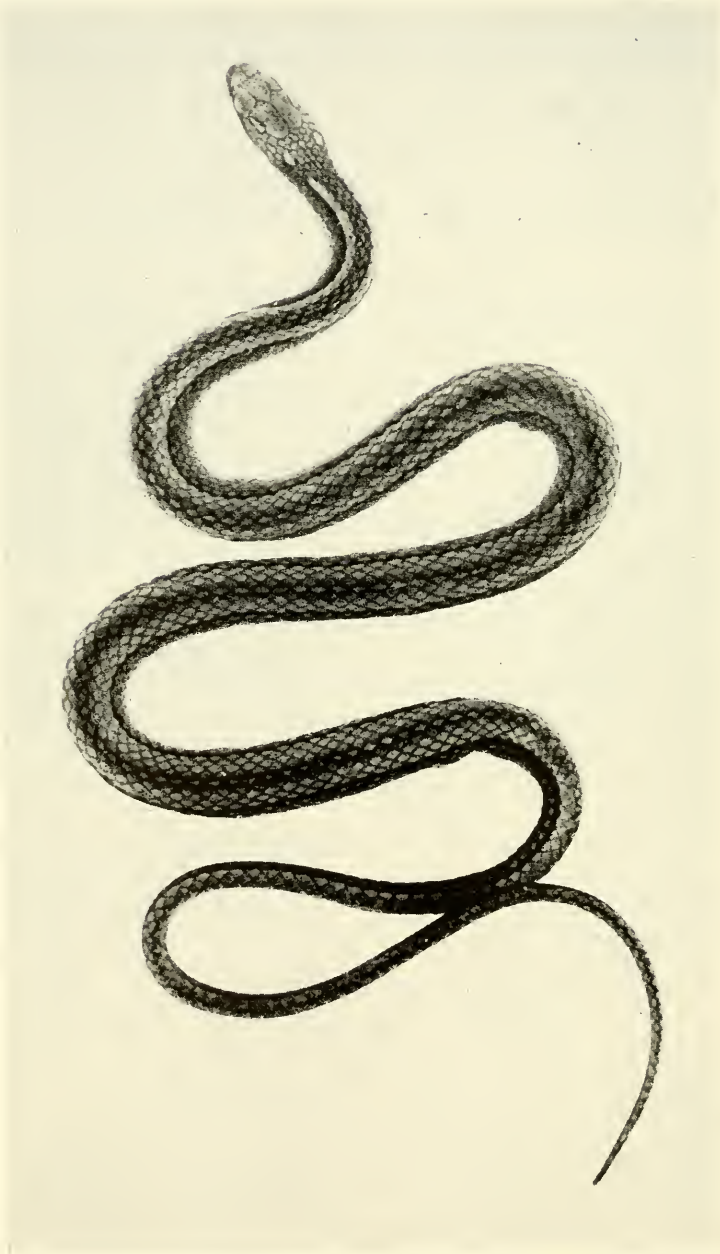


PLATE XI. *Rhadinaea decorata decorata*, MNH No. 25733, La Suiza, Costa Rica, approximate elevation 2400 feet. Total length, 421 mm.

under a small flat rock in a gully. The scale characters of this specimen are as follows:

Eye moderately large; the head distinct from neck; rostral distinctly broader than high, the scale scarcely visible from above; length of internasals in that of prefrontals about one and one third times; width of frontal at least three fifth of its length; length of frontal a third longer than its distance from the end of snout; parietals elongate, equal to their distance from the tip of snout; nasal divided, the posterior part much the largest; loreal nearly square; one preocular (partially divided on both sides) and a small "presubocular" below preocular; two postoculars, only one touching the temporal; formula for temporals, 1 + 2 + 3; supralabials 8-8; the fourth and fifth entering orbit; infralabials 10-10, five touching chinshields; first pair of chinshields about one sixth shorter than the second pair; latter in contact for nearly half their length; scales without apical pits, finely striated but not keeled. Ventrals 126; subcaudals 94 +; anal divided; total length, 421 mm.; tail, 160 mm.

Top and upper part of the sides of head brownish cream with minute blackish flecks, the bones semitransparent so that the brain can be seen dimly. Lips and chin white. A black line borders the upper labials to near the jaw angle; an elongate black-edged light stripe on outer border of parietal, and another rounded ocellus-like spot on beginning of neck. Middle scale row and two adjoining rows blackish gray beginning on neck; a light cream stripe covering sixth row and parts of adjoining rows (more posteriorly, all or nearly all of these rows). Below this there is a broad, dark gray line extending onto the outer edge of ventrals; this color on ventrals terminates in a black dot on anterior ventrals, which may be dim or almost indistinguishable posteriorly. Anteriorly the first scale row may bear a narrow light line. Below yellowish about neck, changing to orange then to tomato-red on the remainder of body.

In the collection of the U. S. National Museum, I examined six specimens from "Costa Rica", one from Suretka, C. R. The ventral-subcaudal counts on No. 9788 are 120, 88 +; Nos. 30609-30612 have respectively 116, 72 +; 117, ?; 123, 96; 114, ?. The Suretka specimen has 119 ventrals, and 110 subcaudals.

These agree in all essential characters with the specimen described except that sometimes there is a small light spot in front of the upper eye level; sometimes this is absent.

Specimens in Harvard M.C.Z. represent the following localities: Guápiles, Suretka, St. Cecilia and Limón.

The species has a wide distribution throughout Central America and southern Mexico.

Rhadinaea pulveriventris Boulenger

Rhadinaea pulveriventris Boulenger, Catalogue of the Snakes in the British Museum, vol. 3 (addenda and corrigenda), 1896, pp. 635-636 (type locality, Costa Rica).
Liophis (= *Rhadinaea*) *pulveriventris* Wettstein, Sitz. Akad. Wiss. Wien, Math.-naturw. Klasse, Abt. 1, Bd. 143, Heft 1-2, 1934, pp. 34-35 (Volcán Irazú, 1500 m.).

Eye rather small; rostral just visible from above; internasals broader than long, much shorter than the prefrontals; frontal longer than its distance to end of snout, shorter than parietals; loreal longer than deep; one preocular; two postoculars; temporals 1 + 2; supralabials 8-8, fourth and fifth entering orbit; five infralabials touch anterior chinshields, which are shorter than posterior; scales in 17 rows; ventrals 132; anal divided; subcaudals 66.

Reddish brown above; a black lateral line between the fourth and fifth scale row, edged with yellowish on the anterior part of body; these lines widen on neck and head and passing through eye join each other on the end of the snout; upper lip white; belly pinkish yellow, finely speckled all over with blackish.

Wettstein, *loc. cit.*, reports a specimen from Costa Rica. It agrees with the type in essential characters. The following data are from Wettstein's report: Maxillary teeth, 18 + 2; mandibular, 20-21; scale rows, 17; ventrals 149; subcaudals 55; supralabials 8, the 4th and 5th entering eye; first chinshields shorter than second pair, and in contact with four infralabials (5 in type); one preocular; two postoculars; temporals 1 + 2; total length, 444 mm.; tail, 106 mm.

A specimen in Harvard, M.C.Z. No. 15261, from Navarro, Costa Rica, has 129 ventrals and 67 subcaudals; the scale-row formula is 17-17-15. In this specimen the venter is almost immaculate. The pigment flecks are reduced, there being very few along the edges of ventrals. Total length, 500 mm.; tail, 145. In other essential characters the specimen agrees with the type.

Rhadinaea vermiculaticeps (Cope)

Taeniophis vermiculaticeps Cope, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 249 (type locality, Veragua, Panamá).
Rhadinaea vermiculaticeps Cope, Proc. Acad. Nat. Sci. Philadelphia, 1863, p. 101 (Costa Rica).

Scales in 17 rows; one preocular, two postoculars; eight supralabials, the fourth and fifth entering eye; frontal elongate; loreal as long as deep; ventrals 117; anal divided; subcaudals 79.

Yellowish brown on dorsal surfaces with two deep brown dorsal streaks, separated by the width of one scale, diverging on the neck

and extending to the outer posterior angle of the supraocular shield; another dark streak on side of head and body passing through eye; head generally brown above with vermiculations of yellow; labials whitish narrowly edged with brown; chin and belly yellowish white, each ventral with dots on outer borders. Total length 330 mm.; tail 115 mm.

I find one record (Cope, *loc. cit.*) of the species from Costa Rica without definite locality.

Harvard M.C.Z. No. 42764 from Piedras Pecora Ridge, Panamá, has a slight peppering of black on the outer edges of ventrals; a whitish line passing through eye, black bordered. Upper and lower labials with vermiculate blackish flecks, and black sutures.

Rhadinaea persimilis Dunn

Rhadinaea persimilis Dunn, Copeia, 1938, no. 4, Dec. 10, pp. 197-198 (type locality, La Loma, 1500 ft. altitude, Prov. Bocas del Toro, Panamá) (also reported from Cartago and La Suiza, Costa Rica and Eden Mine, Nicaragua).

Scales in 17 rows; temporals 1 + 1; preocular one, postoculars two; a small subocular usually present; supralabials seven or eight, third and fourth, or fourth and fifth entering orbit; infralabials seven or eight, four, in contact with chinshields. Males 137-143 ventrals; subcaudals 96-112.

The color above indefinite gray-brown the scales more or less edged or flecked with black; belly red, immaculate; a black line along edge of ventrals, and adjoining scale row, bordered above by a white line in the middle of first scale row; another white line on middle of the fifth scale row; a light spot on outer anterior corner of parietals, one on second temporal, and one between temporal and the lateral line. A median light spot on fifth vertebral scale behind parietals. Supralabials with black upper borders and faint flecks on rostral and anterior supralabials.

Tail more than one third of total length. Greatest known total length, 440 mm.; tail 188 mm.

The species has been reported from La Suiza and Cartago in Costa Rica.

I have examined the type.

Rhadinaea pachyura pachyura (Cope)

Contia pachyura Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875), p. 145 (type locality, Sipurio, Costa Rica).

Rhadinaea pachyura Dunn, Copeia, No. 4, 1938, p. 198; Notulae Naturae, 1942, No. 108, p. 5.

Scales in 17 rows, smooth and usually lacking pits (sometimes with one pit); head elongate, the rostral not prominent; internasals

wider than long; prefrontals as long as wide; frontal elongate but shorter than parietals; loreal large, higher than long; one preocular; two postoculars, subequal; temporals 1 + 1; supralabials eight, the fourth and fifth entering eye; chinshields equal; tail long, three and three-fifths times in total length, and thickened to near end; ventrals 133; subcaudals 50; total length 335 mm.

Color black, the lower scale row with a rufous shade. Scales of the first row with gray tips; head and a nuchal area brown, with a black line from eye above labials; latter yellowish, unspotted or with spots; belly yellowish, each scale with rather large black spots on sides.

Of this species, I have examined a specimen from Panamá, but have seen none from Costa Rica. The type is from Sipurio, Costa Rica. Dunn, *op. cit.*, states that *Rhadinaea decipiens* intergrades with *R. pachyura.*

Rhadinaea pachyura decipiens (Günther)

Ablabes decipiens Günther, Biologia Centrali-Americana; Reptilia and Batrachia, 1893, p. 105, pl. 37, fig. A (type locality, Irazú, Costa Rica).

?Urotheca lateristriga Boulenger, Catalogue of the Snakes in the British Museum, ed. 2, vol. 2, 1894, pp. 181-182 (*part.*).

Rhadinaea pachyura decipiens Dunn, Copeia, No. 4, 1938, p. 198; Notulae Naturae, No. 108, p. 4-5 (El Cedral de Navarro, San José, and La Palma, Costa Rica).

Scales in 17 rows without pits; temporals, 1 + 1 + 2; preoculars one or two; postoculars two; usually a small presubocular; supralabials eight, fourth and fifth entering eye; four infralabials in contact with the anterior chinshields; loreal present as long as high; frontal elongate, longer than its distance to end of snout; ventrals 131-151; anal divided; subcaudals 113.

Blackish brown above with two narrow yellow lateral lines, the lower on outer scale row most distinct; upper line on fifth scale row; a broad yellow band crosses the temporal region and posterior half of parietals; lower parts yellow, with the corners of the ventral scales blackish.

(SUBFAMILY BOIGINAE)

The following group of snakes, consisting of the genera *Trimorphodon, Leptodeira, Rhinobothryum, Imantodes, Oxybelis, Conophis, Clelia, Coniophanes, Erythrolamprus, Stenorrhina, Scolecophis* and *Tantilla,* are characterized by having the posterior maxillary teeth enlarged and grooved. They are often placed in the Subfamily Boiginae (Family Boigidae, [*auctores*]). It may be regarded as doubtful that a close relationship is indicated by the

dental character of grooved teeth since the groove varies considerably in its depth as well as its position on the tooth. Characters other than dentition show differences of such magnitude as to suggest that the grooved posterior fangs have developed several times in the evolution of the group. Hence the subfamily is only a term of convenience.

Some of these snakes are known to be mildly poisonous; none are known to be dangerous to man. The genera of the group likewise vary in size, *Tantilla* and *Scolecophis* being small snakes, while *Clelia* and *Trimorphodon* reach a length of considerably more than a meter. Species of *Oxybelis* have long sharp-pointed heads while those of *Imantodes* have short blunt heads. Both are aboreal in habit with slender compressed bodies. *Trimorphodon* and *Leptodeira* are at least partially arboreal. *Coniophanes, Conophis, Stenorrhina, Tantilla, Scolecophis, Clelia, Rhinobothryum* and *Erythrolamprus* are, so far as I know, terrestrial in habit. Species of *Rhinobothryum* and *Erythrolamprus* in general coloration tend to resemble the poisonous snakes of the genus *Micrurus* and may sometimes be mistaken for species of this group. The name "Corales" is applied to all snakes banded black and red, or black, yellow, and red in Costa Rica.

KEY TO THE "OPISTHOGLYPH" COLUBRIDAE OF COSTA RICA

1. Anal scale entire ..... *Clelia*
   Anal scale divided 2
2. Internasal and anterior nasal fused ..... *Stenorrhina*
   Internasal and anterior nasal not fused 3
3. Loreal usually absent 4
   Loreal present 5
4. Small, short, cylindrical snakes, terrestrial; the head short, scarcely or not distinct from body ..... *Tantilla*
   Elongate arboreal snakes with very slender bodies; head distinct from body, much-elongated (loreal present in one species) ..... *Oxybelis*
5. Two loreals present (rarely more); 10-11 maxillary teeth, the anterior distinctly longer than posterior, followed after an interspace by two moderately enlarged grooved fangs ..... *Trimorphodon*
   A single loreal present; maxillary teeth variable, the interval present or not between maxillary teeth and grooved fangs 6
6. Pupil round 7
   Pupil vertically eliptic 8
7. Maxillary teeth 20-25 forming a continuous series the last three to five largest, grooved; scales 15-17 rows smooth or feebly keeled with apical pits, arranged in oblique transverse rows; usually unicolor ..... *Oxybelis*
   Maxillary teeth 10, slightly increasing in size posteriorly, followed after an interspace by two very large grooved fangs; scales 17-19, smooth, lacking apical pits; pattern of stripes ..... *Conophis*
8. Pattern of red, black, and light (white or yellow) bands 9
   Pattern banded or spotted (large or small spots) lacking red color 10
9. Scales in 15 rows, smooth, without apical pits; ventrals less than 210; subcaudals less than 70; maxillary teeth subequal, followed after an interspace by feebly grooved fangs ..... *Erythrolamprus*

Scales in 21 rows; smooth anteriorly, partly keeled posteriorly; ventrals more than 200; subcaudals more than 70; maxillary teeth equal, followed after an interval by two grooved fangs.....*Rhinobothryum*

10. Completely banded with rings of black and yellow; scales in 15 rows, smooth, lacking apical pits .....*Scolecophis*
Not banded with rings of black and yellow..... 11

11. Pattern unicolor or with some darker longitudinal stripes; or a pattern of black, and cream, stripes; scales in 17-25 rows, smooth, lacking pits.....*Coniophanes*
Lacking such patterns..... 12

12. Body moderately slender; scales in 19-25 rows, smooth or faintly keeled with apical pits; ventrals less than 215; spots or wide bands of darker color....*Leptodeira*
Body especially slender and elongated; vertebral row of scales often enlarged; ventrals more than 215; pattern of spots forming blotches or saddles; or forming numerous small punctations.....*Imantodes*

Genus TRIMORPHODON Cope

Trimorphodon Cope, Proc. Acad. Nat. Sci. Philadelphia, 1861, p. 297.

Genotype: *Trimorphodon lyrophanes* (Cope).
One species is known from Costa Rica.

Trimorphodon biscutatus biscutatus (Duméril, Bibron and Duméril)

Dipsas biscutata Duméril, Bibron and Duméril, Erpétologie Générale, vol. 7, pt. 2, 1854, pp. 1153-1154 (type locality, Mexico).
Trimorphodon biscutatus Cope, Proc. Acad. Nat. Sci. Philadelphia, 1861, p. 297.

The presence of this species in Costa Rica is attested by two specimens in the Museum of Comparative Zoology, Harvard College, Nos. 16186, Puntarenas, Costa Rica, and 15306, Esparta, Costa Rica.

The larger of the two specimens has the following characters: rostral visible above as a broad triangle; internasal suture a little more than a half the length of the prefrontal suture; frontal a fourth longer than wide, a little shorter than its distance from tip of snout; three preoculars, the lower small and more or less below eye (subocular); three postoculars; 3 + 4 temporals, three loreals, the two upper largest, more or less quadrangular; supralabials 9-9, the fourth and fifth enter orbit; infralabials 12-13, four or five touching first chinshields, which are double the size of second pair; scale formula 25-27-19-18, the six median scale rows on latter half of the body keeled; ventrals 262; subcaudals 85.

Pale grayish or brownish gray, with dark black-edged crossbars or black-edged markings with a light center. Head with chevron-like dark bands separated by similar light areas; a series of light black-edged spots on alternating (or every third) ventrals; these may connect with the transverse spots of dorsum; anteriorly a median white stripe 40 mm. long. The specimen is a very large one, having a total length of 1510 mm., the tail 238 mm.

Genus LEPTODEIRA Fitzinger

Leptodeira Fitzinger, Systema Reptilium, 1843, p. 27.

Genotype: *Coluber annulatus* Linnaeus.

Six species of the genus have been reported from Costa Rica.

KEY TO SPECIES OF LEPTODEIRA IN COSTA RICA

1. Body with 16 or less black bands; scales in 19 rows; body with the black bands three to four times broader than interspaces of whitish ground color; head black with a white collar; tail with eight black bands.....*nigrofasciata*
   Body with 20 or more black bands or spots..... 2
2. Spots on body more than 40..... 3
   Spots on body less than 40..... 5
3. Body red, banded with black; below salmon color, dusted with brown; a few undivided subcaudals follow anus; scales in 23 rows; 61 dorsal black spots...*rubricata*
   No red on body, but body usually fawn or light brown; 40-55 black spots or bands across body. Arboreal forms with somewhat compressed bodies..... 4
4. Scales of vertebral row (or rows) enlarged; 19-21 scale rows; about 52 small spots along back; lateral alternating spots dim.....*annulata annulata*
   Scales of vertebral row not enlarged; scales in 21-23 rows; spots larger, approximately 38 in number, somewhat quadrangular, usually edged with lighter color suggesting ocelli; secondary lateral spots present.....*ocellata*
5. Spots less than thirty, terrestrial forms; scale rows 23-25; crescent light spot on head interrupted medially by a black stripe connecting dark of head with neck band. One preocular (usually); abdomen yellowish white.....*rhombifera*
   Spots 20, scales in 21 rows; one preocular; one postocular; white below*....*maculata*

Leptodeira nigrofasciata Günther

Leptodeira nigrofasciata Günther, Ann. Mag. Nat. Hist., ser. 4, vol. 1, 1868, p. 425 (type locality, Nicaragua).

The type description gives the following data on the species: scales in 19 rows; internasals nearly square, two thirds the size of the prefrontals; frontal equal to its distance from tip of snout, and a little shorter than the occipitals; loreal as high as long; one preocular, not quite reaching the frontal; a minute preocular on one side; one postocular; eight supralabials, the third, fourth and fifth border eye; none touching the parietal; temporals 1+2+3; ventrals 174, subcaudals 74.

Body with 16 elongate crossbands, which are from three to four times longer than the interspaces of whitish ground color, and confluent on posterior part of trunk. Head black above, separated by a white collar from the first black band; tail with about eight black bands. Lower parts whitish.

Two specimens have been reported from Costa Rica, one from a specific locality (Turrialba).

* Characters of the type.

Leptodeira rubricata (Cope)

Sibon septentrionale rubricatum Cope, Proc. Amer. Philos. Soc., vol. 31, pp. 333-347 (type locality, Boca Mala, Costa Rica).

Snout short, body robust; head with temporal region swollen, not especially distinct from neck; supralabials eight, the fourth and fifth enter orbit; two preoculars, two postoculars; scales in 23 rows; five undivided subcaudals follow vent; ventrals 178.

Above bright red; on venter light salmon, dusted with brown; 61 transversely oval black spots on the back which cover 12 rows of scales transversely and two and one half to three and one half longitudinally; small black spots alternate with them on third row of scales, and a less definite row of smaller spots alternate with these on second and third rows; a black band extends from eye to last labial plate and behind and above it a parallel black band extends from the parietal plate. The extremities of these bands are fused with the first dorsal spot, the interspaces being red; supralabials red with a black spot in the center of each plate; infralabials black spotted; top of head dark brown bordered posteriorly on outline of parietal plates by a red crescent; this bordered posteriorly by a black crescent, and cut by a median black stripe, which connects the dark brown of the head with the anterior four black dorsal spots. Tail blackish red, spotted above; total length, 660 mm.; tail 133 mm.

This seemingly is a species of the Pacific lowlands. It would appear to be easily recognized by the red coloration; however, only the type is known.

Leptodeira annulata annulata (Linnaeus)

Plate XII

Coluber annulatus Linnaeus, Amoen. Acad., Tom 1, no. 5, p. 120; Systema Naturae, 10th ed., 1758, vol. 1, p. 224; Andersson, Bihang till K.S.U. vet.-Akad. Handl., Bd. 21, afd. 4, 1899, p. 21.

Leptodeira annulata annulata Dunn, Proc. Nat. Acad. Sci., vol. 22, 1936, pp. 692-693 (both coasts; up to 2000 meters elevation at Tierra Blanca, Costa Rica).

The type locality of this form is not known. The six cotypes have the following scale counts: 5 with 19 rows, one with 21. Ventrals 185-193; subcaudals 80-91.

This subspecies occurs in Costa Rica and differs from the more northern form, *polysticta*, in having the scales of the vertebral series enlarged and in lacking the longitudinal dark mark on the neck.

Three specimens of *Leptodeira* are referred to this species. They are M.N.H. No. 25742, taken about five miles southwest of Turrialba; M.N.H. No. 25743 and R.C.T. No. 1462, taken at Los Diamantes,

one mile south of Gúapiles, Costa Rica. No. 25742 is young and the markings are more distinct than in the older specimens, in which some details of the pattern are obscured. Data on markings are taken from that specimen.

Top of head brown; a pure-white horseshoe-shaped mark begins behind eye and passes around behind the parietals (encroaching slightly on the sides of parietals); the width of the mark on the mid-line equal to from four to five scale lengths; behind this a brown spot sending forward narrow arms that reach the eye; supralabials with a light peppering of brown pigment; chin whitish with some little pigment on anterior part; about 52 spots along middle of back; on the sides, alternating with the median spots, can be discerned faint brownish narrow vertical spots; the dorsal ground color is lavender brown, somewhat mottled. Ventrals immaculate save for an occasional brownish speck on outer edge of scales.

The older specimens have the nuchal white band completely obscured, being pigmented as much as other dorsal areas between spots on the body.

Characters of head scales not listed in the following table are: rostral visible above as a narrow line; internasals at least two thirds the length of prefrontals; latter scales about as wide as long, separated from supraoculars by upper preocular; frontal, in contact with preocular, three fourths as wide as long, its length a little greater than its distance from end of snout; parietal nearly as wide as long, equal to its length from internasal-prefrontal suture, or a little longer; nasal at least partially divided; loreal longer than high; two preoculars, two postoculars, the upper much the larger in each case.

Three Costa Rican specimens in the U. S. National Museum, collected by William Gabb were examined (Nos. 32565-67). No. 32566 ♀ has 203 ventrals and 79 + subcaudals; No. 32565 has 197 ventrals and 93 subcaudals; the scale rows are 21 in the middle of body in both. No. 32567 is in a bad state, and counts were not attempted.

A Harvard M.C.Z. specimen from Limón, Costa Rica has 197 ventrals, 82 subcaudals; scale formula, 21-23-19-16. While this is a young specimen, it lacks the large white crescentic area described in the Turrialba specimen.

SCALE DATA ON LEPTODEIRA ANNULATA ANNULATA

No.	Sex	Ventrals	Subcaudals	Preocular	Postocular	Supra-labials
25742	(yg.)	201	92	2	2	8–8
25743	♀	199	59+	2	2	9–8
1462	♂	199	94	2	2	8–9

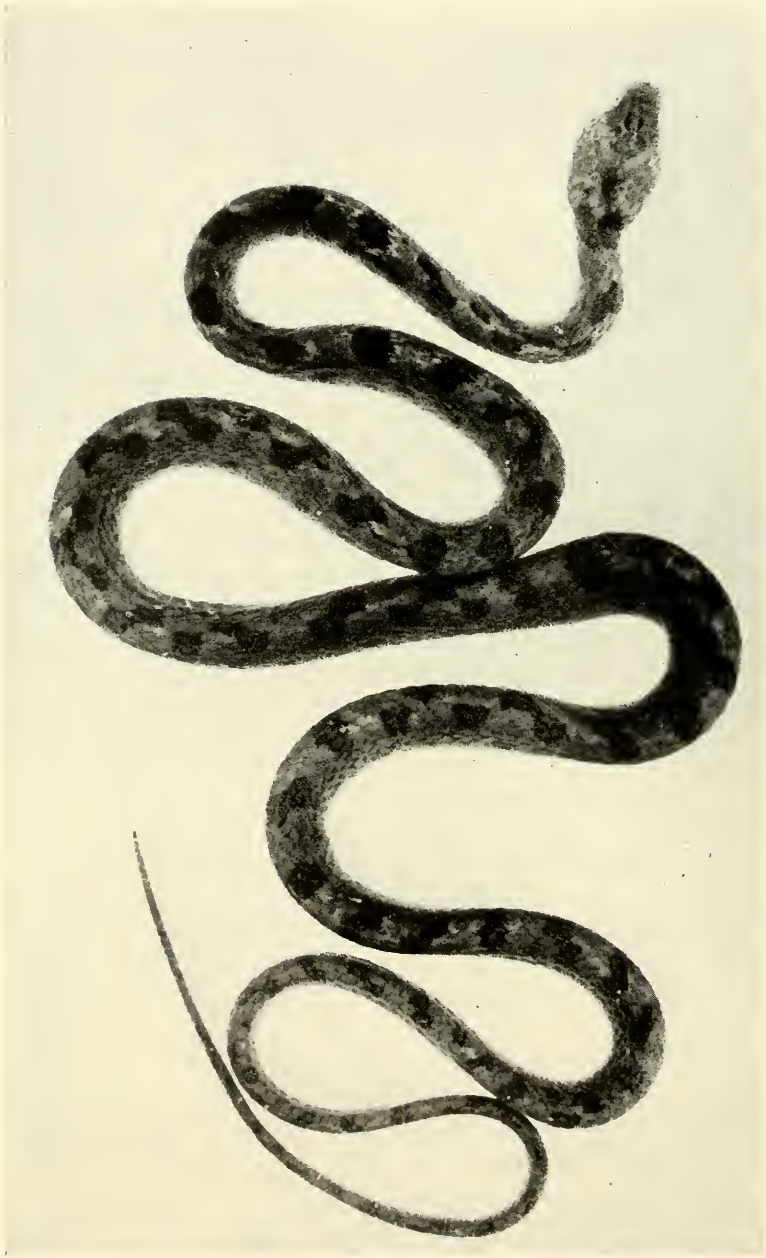


PLATE XII. *Leptodeira annulata annulata*, RCT No. 1462, Los Diamantes, Costa Rica, September 7, 1949, approximately natural size.

SCALE DATA ON LEPTODEIRA ANNULATA ANNULATA (concluded)

No.	Infra-labials	Scale formula	Body bands	Temporals	Labials contact chinshields	Labials enter orbit
25742	11–11	21–21–15	52	1 + 2 + 3 1 + 2 + 2	6–6	4–5
25743	11–11	19–23–15	49	1 + 3 + 4 1 + 3 + 3	6–6	5–6
1462	10–11	21–21–15	50	1 + 2 + 3	5–5	4–5

Leptodeira ocellata Günther

Leptodeira ocellata Günther, Biologia Centrali-Americana; Reptilia and Batrachia, May 1895, pp. 172-173, pl. 55, fig. B (type locality, Chontales Mines, Nicaragua; Costa Rica).
Leptodeira rhombifera (*part.*) Dunn, Proc. Nat. Acad. Sci., vol. 22, 1936, pp. 693-694.

The following data are taken from the type description: scales in 23 rows; internasals about one third of the prefrontals; frontal a little shorter than parietal; loreal large, square; preoculars two, the lower very small, the upper reaching the frontal, or nearly so; rarely a portion of a labial forms a small presubocular; two postoculars; eight supralabials, of which the fourth and fifth border eye; temporals 1 + 2 + 3; the two pairs of chinshields of equal length; ventrals 165-170.

Ground color reddish, or brownish olive; a series of dark brown transverse or irregularly rounded spots along the back, which do not descend to the sides and are about 38 in number on the trunk; sides with a series of round brown spots, the spots being opposite to the interspaces of the ground color and accompanied by smaller irregular spots; neck without a distinct collar and longitudinally divided in the middle by a narrow line proceeding from the first dorsal spot. Upper side of head mottled brown; a brown temporal band. Lower parts yellowish.

A specimen from Miramar, Costa Rica (U. S. National Museum No. 75037) has the following characters: a median groove in anterior part of frontal; two preoculars, the upper preocular barely separated from frontal; frontal pentagonal, the sides parallel; supralabials 8-8; infralabials 10-10, five touching first chinshields; scale formula 21-23-17; ventrals 171, subcaudals 90. There are 32 bands or spots on dorsum of body; approximately 28 on tail, those near tip indistinct. A series of small lateral spots alternate with these; venter immaculate; a bilaterally symmetrical mark on the frontal and a tridentlike mark on neck; some irregular spotting on parietals. The dorsal spots usually touch the fourth scale row.

Leptodeira rhombifera Günther

Leptodeira rhombifera Günther, Ann. Mag. Nat. Hist., ser. 4, vol. 9, 1872, p. 32 (type locality, Rio Chisoy near Cubulco, Guatemala).

This species has been reported from Costa Rica but the reports may be based on other forms. I append a brief description from Günther.

Scales in 25 rows; internasals very small; frontal as long as the snout; loreal longer than high; one preocular barely touching frontal; two postoculars; eight upper labials, of which the fourth and fifth enter the orbit; temporals 1 + 2 + 3; chinshields rather elongate, the pairs equal in length; body slender; head broad and depressed; ventrals 170.

Brownish above, the body with about 26 large subrhombic dark brown spots edged with black; yellowish cross bands brightest on median line separate the rhombic spots; upper part of head brown powdered with black; a black stripe with a yellowish margin on each side connects the crown of the head with the first rhombic spot. Abdomen yellowish, subcaudals powdered with brown.

Leptodeira maculata (Hallowell)

Megalops maculatus Hallowell, Proc. Acad. Nat. Sci. Philadelphia, 1861, p. 488 (type locality, "Tahiti," [in error]; possibly Costa Rica).
Anoplophallus maculatus Cope, Amer. Naturalist, 1893, p. 480.
?Leptodeira personata Cope, Proc. Acad. Nat. Sci. Philadelphia, 1868 (1869), p. 310.
Leptodeira septentrionalis maculatus (*part.*) Dunn, Proc. Nat. Acad. Sci., vol. 22, 1936, p. 397.
Leptodeira maculata Taylor, Univ. Kansas Sci. Bull., vol 25, 1938 (1939) pp. 337-342.

Six specimens in the Museo Nacional de Costa Rica, [presumably] from Costa Rica have been identified as belonging to this species.* I have not seen the specimens.

It seems well to regard the record of this species in Costa Rica as doubtful until the form is rediscovered there.† The species is a northern one, occurring widely in Mexican lowlands.

The following characters of the type will assist in identifying *maculata*. Body moderately slender, and relatively short; prefrontals double the length of the internasals (the prefrontals are fused for more than half their length [abnormal?]); loreal elongate, much longer than high; one preocular well separated from frontal, with a curved rather than an angular front edge; one postocular (seem-

* Reported by Dunn in Proc. Nat. Acad. Sci., vol. 22, 1936, p. 697. This paper, purporting to be a revision of the Genus *Leptodeira* has attempted to unite the genus *Hypsiglena* with *Leptodeira*, and has in numerous instances wrongly synonymized forms. *Maculata* has been made a subspecies of *septentrionalis*. These two species occur together over much of the area of their distribution, and are not closely related within the genus.

† I am not wholly convinced that the form described by Hallowell is identical with *Leptodeira personata* Cope. I had hoped to find the Costa Rican species but no specimens were taken.

ingly); fourth and fifth labials enter eye; first light band six scales long; no elongate stripe on nape; 20 dark spots across body, 9 + on tail; ventrals 171; 61 + subcaudals, the tip of tail missing. Scales in 21 rows; anal divided.

Some of the spots are broken and tend to alternate or are irregular. The contrast between the spots and the light areas between them, very pronounced. The head markings are indiscernible save that the frontal appears a little darker than other dorsal head scales and the edges are somewhat lighter.

Genus OXYBELIS Wagler

Oxybelis Wagler, Natürliches system der Amphibien, 1830, p. 183.

Genotype: *Oxybelis acuminatus* = *aeneus* (Wagler).

Three species occur in Costa Rica.

KEY TO SPECIES OF OXYBELIS IN COSTA RICA

1. Scales in 15 rows (15-15-13); ventrals 177, subcaudals 162; supralabials 6, *brevirostris*
   Scales in 17 rows 2
2. Ventrals 198-217; subcaudals 139-165; supralabials 9-10 ..... *fulgidus*
   Ventrals 174-203; subcaudals 150-188; supralabials 8 ..... *aeneus*

Oxybelis fulgidus (Daudin)

Coluber fulgidus Daudin, Histoire naturelle des Reptiles, vol. 6, 1803, p. 352, pl. 80 (Port au Prince, San Domingo *ex errore*).

Oxybelis fulgidus (*part.*)Duméril, Bibron and Duméril, Erpétologie Générale . . . , vol. 7, pt. 2, 1854, pp. 817-819; Boulenger, Catalogue of the Snakes in the British Museum, vol. 3, 1896, pp. 191-192.

Snout very elongate, pointed, its length three times diameter of eye, flat at end and prominent; rostral scarcely visible above; internasals elongate, a little shorter than elongate prefrontals; frontal narrower than supraoculars, nearly twice as long as broad, subequal in length to prefrontals and parietals; loreal absent; nasal single, very small; prefrontal contacts two or three labials, not entering eye; preocular one, not reaching frontal; postoculars one or two; temporals large, 1 + 2; supralabials nine or ten, usually the fourth, fifth and sixth (fifth, sixth and seventh) enter the eye; four infralabials border anterior chinshields, which are but little more than half size of posterior pair. Scales in 17 rows, the dorsals feebly keeled. Ventrals 198-217; anal divided; subcaudals 139-165.

Bright green above, yellowish green below and on upper lip; a yellowish white line along each side of venter and in subcaudal area. Reaches a length in excess of one and a half meters.

Ranges from Yucatán, Mexico, into South America.

Oxybelis brevirostris (Cope)

Plate XIII

Dryophis brevirostris Cope, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 555 (type locality, Veragua, Panamá); and Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875), p. 132, pl. 26, fig. 2 (southeastern Costa Rica).

Oxybelis caerulescens Jan, Elenco Systematico degli Ofidi, 1863, p. 88.

Oxybelis brevirostris Boulenger, Catalogue of the Snakes in the British Museum, 2nd ed., vol. 3, 1896, p. 190; Andersson, Göteborg Kungl. Veten. Vitt. Samh. Hand., vol. 17, 1914 (1916); Medd. Göteborgs Mus. Zool. Afdel. 9, p. 36 (Siquirres, Costa Rica).

A specimen of this very slender tree snake was captured at Los Diamantes by Richard C. Taylor (No. 366). It agrees with specimens reported by Cope in having the scales almost, if not entirely, smooth.

Body slender, compressed, rostral visible above; the suture between rostral and internasals a transverse line; internasals one sixth shorter than prefrontals; length of frontal equals parietal length and also equals its distance from rostral, its width in length at least twice; parietals followed by two greatly enlarged upper secondary temporals, which are separated mesially by a smaller scale; nostril in single elongate nasal; no loreal; a large preocular touches frontal; supraoculars as long as, but much wider than, frontal; one postocular; temporals 1 + 2, extremely large; supralabials 6-6 in following order of size: 1, 2, 3, 5, 4, 6; infralabials 7-7; two pairs of chinshields, the posterior narrower, but a little longer than the first pair; scale formula 15-15-13, smooth, the vertebral row somewhat enlarged; ventrals 177, subcaudals 162; anal single; total length 872 mm.; tail 348 mm.

Color uniform greenish tending to become purplish or lavender in preservative. I have examined also two specimens from Costa Rica collected by William Gabb (U. S. National Museum Nos. 30559-30560. The ventrals are 178 and 176 respectively; the subcaudals 75 +, 159.

Oxybelis aeneus (Wagler)

Dryinus aeneus Wagler, in Spix, Serpentum Brasiliensium, 1824, p. 12, pl. III (type locality near Ega, Brazil).

Oxybelis aeneus auratus (*part.*) Bogart and Oliver, Bull. Amer. Mus. Nat. Hist., vol. 83, 1945, pp. 381-392.

Oxybelis acuminatus Boulenger, Catalogue of the Snakes in the British Museum, vol. 3, 1896, pp. 192-193 (Irazú, Costa Rica).

The status of this name for this form is somewhat uncertain. Presumably following Schmidt's suggestion (Field Mus. Nat. Hist. Zool. Ser., vol. 24) Bogert and Oliver, *loc. cit.*, combine several recognized species into a single "species" extending from Arizona to

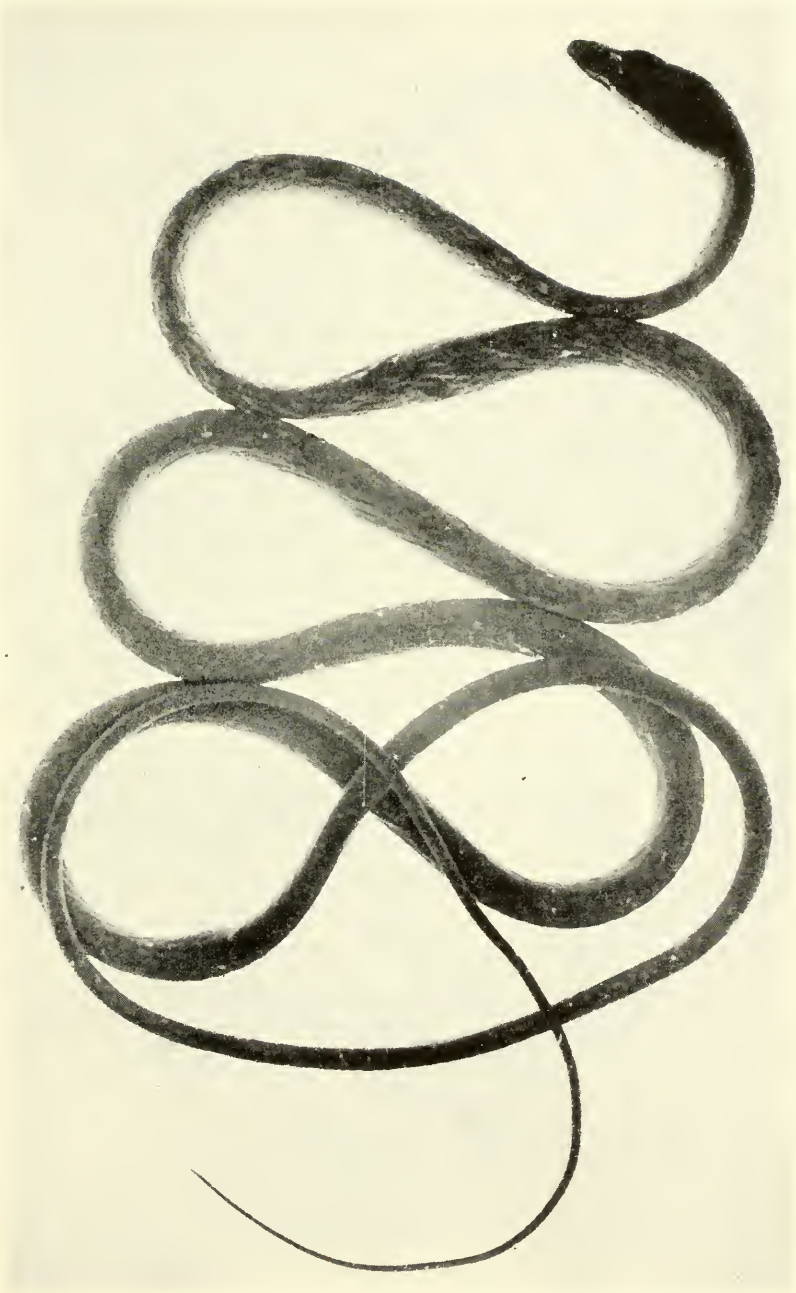


PLATE XIII. *Oxybelis brevirostris* (Cope), RCT No. 1366, Los Diamantes, Costa Rica, September 4, 1947. Approximately natural size.

Brazil. They state, "Whereas this material is representative it is, of course *quite inadequate* for any satisfactory study of a variable form ranging over large portions of two continents. The conclusions we are able to draw therefore must be considered tentative . . ." They have however shown that the name *aeneus* of Wagler, antedates *acuminatus* of Wied, the name under which this species has long been known.

The following characters will identify this form in Costa Rica: snout narrow, elongate, sharply pointed, the rostral usually not visible from above; snout three to three and one-half times eye diameter; internasals slightly shorter than the prefrontals; frontal long, narrow, the width slightly more than half of length; parietals slightly longer than frontal; nasal slender, small, single; no loreal; prefrontal touching three supralabials; one large preocular; postoculars two; temporals large, 1 + 2; supralabials eight, five and six enter eye; nine infralabials, four in contact with first chinshields.

Scales in 17-17-13 rows, smooth or faintly keeled; ventrals 174-203; subcaudals 150-188; anal divided. Variable in color; green, bronzy, grayish or reddish above, uniform or flecked with brown; a black line on the side of the head; yellowish or brownish on venter, speckled or streaked with brown, often with scattered black dots.

Reported from "Irazu" Costa Rica by Boulenger.

Genus IMANTODES Duméril and Bibron

Imantodes Duméril and Bibron, Mem. Acad. Inst. France, vol. 23, 1853, p. 507.

Genotype: *Coluber cenchoa* Linnaeus.

Three species of the genus occur in Costa Rica.

KEY TO SPECIES OF IMANTODES IN COSTA RICA

1. Scales of the median vertebral row less than twice the width of adjoining scales; ventrals 202, subcaudals 115 ..... *inornatus*
   Scales of median vertebral row twice (or more) as wide as the adjoining scales 2
2. Scales of median row three to four times width of adjoining scales; ventrals 233-252; subcaudals 157-171 ..... *cenchoa semifasciatus*
   Scales of median row twice width of adjoining scales; ventrals 220-237; subcaudals 114-146 ..... *gemmistratus*

Imantodes inornatus Boulenger

Plate XIV

Himantodes inornatus Boulenger, Catalogue of the Snakes in the British Museum (Natural History), vol. 3, 1896, p. 88, pl. 5, fig. 1 (type locality, Hda. Rosa de Jérico, 3250 ft., Nicaragua).

A specimen of this species (M.N.H. No. 25158) was acquired at Isla Bonita (American Cinchona Plantation) on the east slope of Volcán Poás.

PLATE XIV. *Imantodes inornatus*, MNH No. 25158, Isla Bonita, Costa Rica, about natural size.

Head broad with a very narrow neck; rostral about twice as wide as high, the part visible above forming a very narrow line; internasals large, their length about two thirds that of the prefrontals and about one half of their area; prefrontals minutely wider than long; frontal slightly less than twice as long as wide, narrower than the supraoculars, equal to its distance from snout tip; supraoculars very large, of greater area than frontal, about one-third longer than wide, about one-seventh shorter than parietals; latter scales relatively short, longer than wide, their length equal to their distance to a point little beyond middle of prefrontals; nostril in a single nasal; loreal as long as high; a single preocular, very narrow and high; two postoculars; temporals $1 + 2 + 3$.

Supralabials 8-8, in the following ascending order of size: 1, 2, 4, 3, 8, 5, 6, 7; third, fourth, and fifth supralabials enter orbit; eye very large, equal or minutely less than its distance from the end of snout, the pupil vertical; anterior chinshields a little shorter than posterior; infralabials 9-9, the first six border first pair of chinshields. Scales smooth, the median row slightly, but not abruptly enlarged; scale formula, 17-17-17; ventrals 202; subcaudals, 115; anal divided. Total length, 821 mm.; snout to vent, 586 mm.; tail, 235 mm.

Above fawn with scattered black flecks or dots on head, a pair on the posterior part of the parietals largest; a dim elongate mark on neck behind parietals. Body with indistinct, extremely narrow, darker, transverse markings across the back where they tend to contact the upper points of a zigzag line indicated only by minute black flecks; the markings on tail similar but less distinct. Ventrals with a peppering of black; pigment concentrated so as to form a somewhat darker median line; chin lacking pigment. This specimen agrees in rather remarkable detail with the type description.

A second specimen examined (U. S. N. M. No. 15318) has 204 ventrals and 96 subcaudals. Otherwise it agrees with the type in essential characters.

Imantodes cenchoa semifasciatus Cope

Plate XV

Himantodes semifasciatus Cope, American Nat., 1894, p. 613.
Imantodes cenchoa semifasciata Smith, Proc. U. S. Nat. Mus., vol. 92, 1942, pp. 384-385.

This extremely slender, greatly elongated snake was found usually in trees either under bark or coiled in growing bromelias. Its large eyes suggest that it is of nocturnal habits. The specimens were extremely gentle, moving with great deliberation and allowing themselves to be handled without showing fear.

Of the six specimens of this species that I have at hand, the three

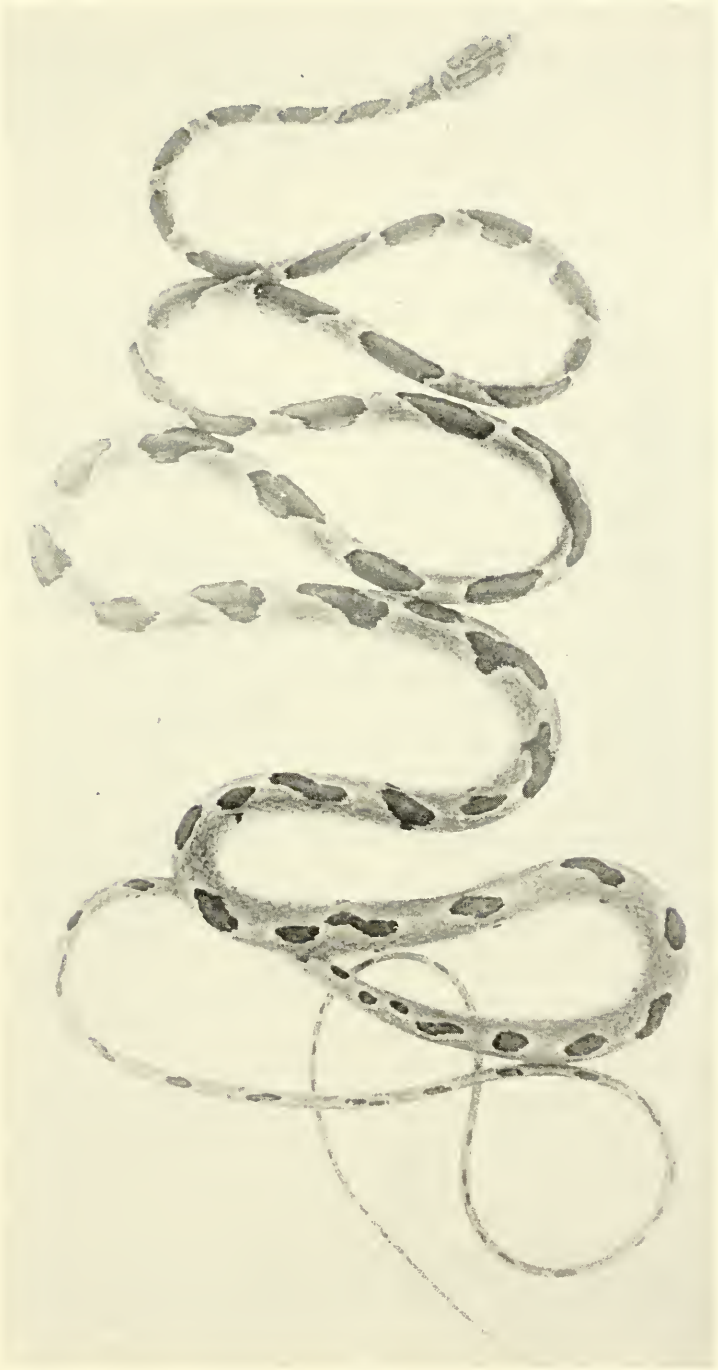


PLATE XV. *Imantodes cenchoa semifasciata* RCT No. 1370, Los Diamantes, Costa Rica. September 1-8, 1947; about natural size.

from rather high elevation (5-6000 ft. elev.) do not offer constant differences from those taken in lowlands (800 to 900 ft.).

R. C. T. Nos. 644, 829, 830 are from the region about Turrialba. R. C. T. No. 1370, M. N. H. Nos. 25700 and 25680 are from Los Diamantes, 1 mi. south of Gúapiles.

There is no variation in the number of the supralabials, the fourth and fifth enter the orbit in all. Five is the normal number of infralabials touching the first chinshields, six occuring two times in twelve. The temporals however are irregular; formulae such as $3+3+4$, $2+2+3$, $2+2+4$, $2+3+3$, $\frac{1+2}{1}$, $3+3$, $4+4$, and $1+2+3$ occur.

Males are characterized by tubercles on the chinshields and occasionally on adjoining infralabial scales. Sometimes the second pair of chinshields is separated by one or more small scales; sometimes they are together.

The spots over the anterior part of the body tend to reach the ventrals, but all do not. Practically all spots are brown narrowly bordered by blackish brown and this color is in turn bordered by scales that are cream, and lacking pigment for the most part. There may be a few irregular black spots on sides near the edges of the ventrals, opposite the main spots or possibly alternating with them.

This species may readily be diagnosed by the following characters in addition to those given: head two to three times as wide as the narrowest point of neck; eye very large, nearly equal to its distance from the tip of snout; a small loreal present; scales smooth without apparent apical pits, the scales of the median row somewhat quadrangular, three to four times the width of adjoining row; the scale formula is 17-17-17.

I have examined four specimens in the U. S. National Museum from "Costa Rica". The number of spots varies from 42-47 on body.

There are two specimens, Nos. 15309, Zent, Costa Rica and 19338 from Suretka, C. R., in the Harvard M.C.Z.

The species is known from numerous localities in Costa Rica where it is called Bejuquilla. The name, however, is doubtless also applied at times to other slender snakes.

DATA ON IMANTODES CENCHOA SEMIFASCIATUS

No.	Sex	Supra-labials	Infra-labials	Pre-ocular	Post-ocular	Ventrals	Sub-caudals	Anal	Body spots
644	♀	8–8	9–10	1–1	2–2	246	...	1	43
829	♂	8–8	10–10	1–1	2–2	252	166	2	48
830	♂	8–8	11–12	1–1	2–3	252	91+	2	49
1370	♂	8–8	10–10	1–1	2–2	249	168	2	48
25700	♂	8–8	10–10	1–1	3–3	248	171	2	..
25680	♀	8–8	9–10	1–1	2–2	233	157	2	..

Imantodes gemmistratus Cope

Himantodes cenchoa Cope (*nec* Linnaeus), Proc. Acad. Nat. Sci. Philadelphia, vol. 12, 1860, p. 264 (near Isalco, San Salvador).

Himantodes gemmistratus Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 13, 1861, pp. 296-297 (type locality, near Izalco, Salvador).

Imantodes gemmistratus Smith, Proc. U. S. Nat. Mus., 1942, vol. 92, pp. 385-386 (Chiapas, Nicaragua, Costa Rica, Panamá).

This form, *fide* Smith, is characterized by having most of the median dorsal scales twice the width of the adjoining row. Usually three labials border the orbit; one preocular, two postoculars; ventrals 220-237; subcaudals 114-146.

The bands across body are about 42 in number, usually complete throughout the length of the body.

Cope's type specimen is described as: head short, thick, the temporal regions swollen; scales of the median dorsal series diamond-shaped, longer than broad; one temporal in contact with the postoculars; sixth infralabial largest; the spots on body 42, tending to be connected by a median dorsal vitta; head pale brown, with a few irregular spots; a single apical pit in each scale.

Genus CLELIA Fitzinger

Clelia Fitzinger, Neue Classification der Reptilien, 1826, p. 56.

Genotype: *Clelia daudinii* Fitzinger, substitute name for *Coluber clelia* Daudin.

Two species are known from Costa Rica.

KEY TO THE SPECIES OF CLELIA IN COSTA RICA

Scale rows 17-17-17(15); supralabials 7 (8); juvenile coloration: head and neck black with a nuchal light band several scales wide; body reddish, each scale with a black dot. Adults blackish ..... *clelia clelia*

Scale rows 19-19-17; labials 8, 9; juvenile coloration: black with a series of red transverse bands, complete or broken, three or four scales wide ..... *petalarius*

Clelia clelia clelia (Daudin)

Plate XVI

Coluber clelia Daudin, Histoire Naturelle Générale et Particulière des Reptiles, vol. 6, Year 11 (1803), pp. 330-331, pl. 78 (type locality, Surinam).

Clelia clelia clelia Smith, Proc. U. S. Nat. Mus., vol. 92, 1942, p. 394; vol. 93, 1943, pp. 402-403.

Three specimens of this widespread species were taken, as follows: R.C.T. No. 636 (yg.), 4 mi. E of Isla Bonita at an elevation of about 3600 feet, and M.N.H. No. 25746 (yg.) about 5 miles west-southwest of Isla Bonita at an elevation of about 6300 feet, Aug. 3, 1947. A third adult specimen, M.N.H. No. 25747, was taken at Isla

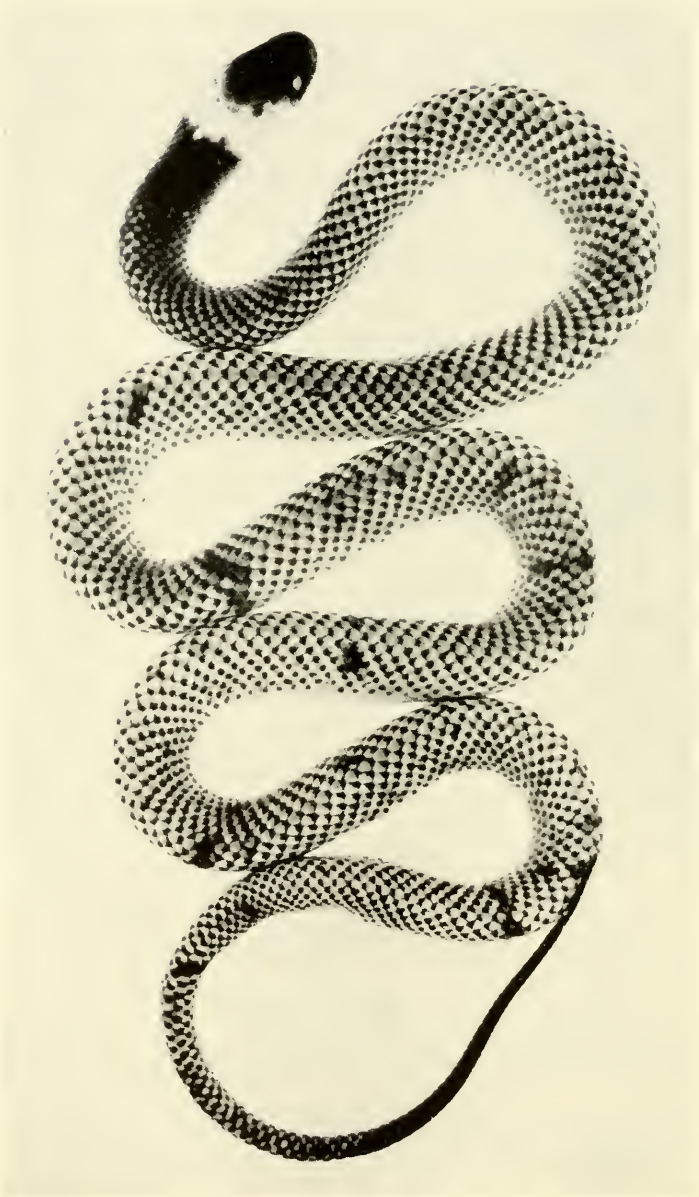


PLATE XVI. *Clelia clelia clelia* (Daudin), MNH No. 25746, 5 miles west Isla Bonita, Costa Rica; approximately natural size.

Bonita on the highway, elevation about 5400 feet. The specimens differ considerably in the character of the marking on the body.

No. 25746: In this specimen the characteristics are as follows: top and sides of head, including parietals, postoculars, and four anterior supralabials brownish black; a cream band on anterior nuchal scales and temporals, with clouding on some of the temporals and on scales touching posterior edge of parietals; width of this band equal to width of four scale-rows; a dorsal blackish spot eight or nine scales wide on neck, which, on its anterior part, reaches to ventrals but posteriorly only to fourth scale row; general color above pinkish; on ventral surfaces cream white; body scales with a blackish area on posterior part of each scale, except outer row less regularly spotted; tail blackish toward tip, ventrals immaculate save for an occasional fleck on outer edges of the scales. Careful scrutiny of body shows a suggestion of bands in a few groups of black flecks on dorsum and sides.

No. 636: The general coloration follows the preceding with the following exceptions. The color above pinkish, the edges of the scales usually darker than centers, there being more pigment on dorsal areas, less on sides; no distinct black spot on each scale; on outer scale row and outer edge of ventrals dim grayish marking suggesting a discontinuous irregular grayish line.

No. 25747, an adult, is blue black, the color extending onto ventrals on each side for one fourth of their width throughout greater part of length. Middle half of ventrals immaculate cream-white with a rosy tinge; chin and infralabials light; supralabials a little lighter than head.

The following scale characters are the same in all the specimens: Supralabials 7-7, the third and fourth entering eye; infralabials 8-8, the first five bordering first chinshields. The temporals, however, are variable. The formulae follow: No. 636, $2 + \frac{1}{2+2}$, $2 + 2 + 3$; No. 25746, $2 + \frac{1}{2+2}$; No. 25747, $2 + 3$.

The following table gives further scale variation:

DATA ON CLELIA CLELIA CLELIA DAUDIN

No.	Sex	Ventrals	Caudals	Scale formula
636	♂	209	82	17–17–15
25746	♀	222	71	17–17–17
25747	♀	228	61	17–17–17

Clelia petolarius (Linnaeus)

Plate XVII

Coluber petolarius Linnaeus, Museum Adolphus Friderici Regis, 1754, p. 35, pl. ix, fig. 2; and Systema Naturae, 1766, 1, p. 387.

Oxyrhopus petolarius Boulenger, Catalogue of the Snakes in the British Museum, vol. 3, 1896, pp. 101-103; Cope, Journ. Acad. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875), p. 132 (Sipurio, Costa Rica).

A single Costa Rican specimen is at hand, collected on the Pacific slope at San Isidro El General (R.C.T. No. 969).

Rostral narrowly visible, its width a little greater than its height; internasals small, about one third area of prefrontals which are very nearly as broad as long; frontal subtriangular, its length about one-sixth longer than wide, and equal to its distance from the middle of the prefrontals, much more than twice as wide as the supraoculars; length of parietal about equal to its distance from the internasal; nostril between two nasals; loreal elongate, nearly twice as long as high; one preocular touching frontal; two postoculars; temporals 2 + 3; supralabials 8-8, the fourth and fifth enter orbit; infralabials 10-10, five touching first pair of chinshields, which are a little larger but about same length as posterior pair; scale formula: 24 (about head) -19-19-17, with paired apical pits. Ventrals 201; subcaudals 79 + 1.

Color above blackish; an occipital reddish band covering extreme tips of parietals and the following four scale rows; this in turn followed by a broad black collar, eleven scales wide; behind this 29 orange-red bands, most of which are continuous across back, but nine or ten separated mesially tending to alternate on opposite sides; ten transverse bands on tail most of which are continuous; red bands are two to three scale rows wide, the intervening black bands six to eight scale rows wide posteriorly (anteriorly, four to five). The belly and chin white; subcaudal region grayish to black, the red bands encircling the tail. The reddish orange bands have the scale edges darkened, occasionally spotted.

The specimen was caught under a small log, about a half mile west of San Isidro El General on the Pacific side of Costa Rica, by Richard C. Taylor.

A specimen in the U. S. National Museum listed by Cope, *op. cit.*, has been examined. There are 202 ventrals and 92 subcaudals in this specimen; scale rows 21-19-19-17; one preocular; two postoculars; temporals 2 + 3; supralabials 8-8; infralabials 10-10; loreal 2½ times as long as wide; anterior chinshields double area of second pair. There are 25 light bands on body.

PLATE XVII. *Clelia petolarius* (Linnaeus), RCT No. 969, San Isidro El General, Costa Rica, August 27, 1947; about natural size.

Genus ERYTHROLAMPRUS Boie

Erythrolamprus Boie, Isis, vol. 19, 1826, p. 981.
Erythrolamprus Wagler, Natürliches System der Amphibien, 1830, p. 187 (*part.*).

Genotype: *Erythrolamprus agilis* Wagler (*fide* Fitzinger).
A single form is known to occur in Costa Rica.

Erythrolamprus bizonus Jan

Erythrolamprus aesculapii bizona Jan, Arch. Zool. Anat. Fis., vol. 2, fasc. 2, 1863, pp. 314-315 (Bahia, Messico, Popayan, Cayenne, Brasile, Montevideo, Colombia).
Erythrolamprus venustissimus Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875, published as separate), p. 141 (Sipurio, Costa Rica).
Erythrolamprus aesculapii (*part.*) Boulenger, Catalogue of the Snakes in the British Museum, vol. 3, 1896, pp. 200-201 (lists a specimen from Irazú, Costa Rica, ventrals 197, subcaudals 50); Picado, Serpientes Venenosas de Costa Rica, 1931, pp. 32-33, fig. 8 (right).

The use of the name *bizonus* for the Costa Rican form of *Erythrolamprus aesculapii* Linnaeus (*E. venustissimus* Wied) is that of Bailey, mentioned in Dunn and Bailey, Bull. Mus. Comp. Zool., Harvard College, vol. 86, no. 1, 1939, p. 12.

Jan has applied this name to a form presumably ranging from Mexico south through Colombia, Cayenne, Brazil and Uruguay. Dunn and Bailey state that, as the original name was somewhat composite, they restrict the name to Colombian specimens with the bands double even on the neck.

I have examined several Costa Rican specimens in the U. S. National Museum and a summary of the scale counts taken is given in the accompanying table. The scale characters are as follows:

The rostral visible above as a narrow triangle; length of common internasal suture about 2½ times in that between prefrontals; frontal about one-fifth longer than its distance to snout tip, nearly as long as parietals; nasal partially divided, the suture above nostril; loreal higher than wide; a large preocular; two postoculars; temporals 1+2; seven supralabials, the third and fourth entering orbit; eight or (usually) nine infralabials, four touching the first chinshields, which are longer than second pair; scale formula 15-15-15, scales smooth; ventrals 181-201, subcaudals 49-59.

Color above red with a series of 13-15½ paired black bands encircling body separated by a narrow red band. A black spot on the head involves supraoculars, frontal, and two thirds of the area of parietals. The labials and scales on tip of snout and some scales on back of head with blackish marks.

Total length (of U. S. N. M. No. 13536) 598 mm.; tail 87 mm. (San José, Costa Rica).

TABLE OF SCALE COUNTS FOR COSTA RICAN ERYTHROLAMPRUS BIZONA

No.	Locality	Body triads	Tail triads	Ventrals	Subcaudals	Supralabials	Infralabials
9784	Costa Rica	$13\frac{1}{2}$	$4\frac{1}{2}$	189	53	7–7	9–7
9779	Costa Rica	$15\frac{1}{2}$	4	198	49	7–7	9–9
13536	San José, C. R.	$15\frac{1}{2}$	4	198	56	7–7	8–9
14013	Costa Rica	$15\frac{1}{2}$	4	198	59	7–7	9–9
30677	Sipurio, C. R.	$15\frac{1}{2}$	4	194	58	7–7	9–9
8312*	Costa Rica	15	4	201	57	7–7	9–9

Genus CONIOPHANES Hallowell

Coniophanes, Hallowell, in Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 12, 1860, p. 248.

Genotype: *Coronella fissidens* Günther.

Three Costa Rican species are referred to this genus.

KEY TO COSTA RICAN SPECIES OF CONIOPHANES

1. Scales in 17 rows; upper parts grayish brown; two narrow yellowish lines on each side, one on the first scale row, the other originating from a spot on neck, and continuing on body as a series of almost contiguous dashlike spots ..... *decipiens*
   Scales in 21-25 rows 2
2. Scales in 25 rows; a light stripe beginning on head passing eye and continuing with the dorsolateral light lines of body (rarely interrupted on neck); a black dorsal stripe present, five to seven scales wide; separated from a lateral black stripe three scales and two half scale rows wide, by a cream stripe somewhat less than three scales wide ..... *piceivittis*
   Scales in 21 rows; above brownish, the median dorsal scales each with a small blackish posterior spot; all scales of body slightly darker on edges; a dim lateral line on 4th and 5th scale row, and a light line on sixth row; venter peppered with fine pigment ..... *fissidens punctigularis*

Coniophanes decipiens (Günther)

Tachymenes decipiens Günther, Biologia Centrali-Americana; Reptilia and Batrachia, 1895, p. 163, pl. 53, fig. A (type locality, Irazú, Costa Rica).

Rhadinaea güntheri Dunn, Copeia, 1938, no. 4, p. 198 (substitute name for *decipiens*).

Dunn's reference of this snake with grooved back fangs to the genus *Rhadinaea*, I consider untenable and the substitute name which he proposed after this action, I believe, should be suppressed.

Body slender, the tail about one half length of body (tail mutilated in the type); snout short; internasals short and small; frontal shorter than parietals, but as long as or a little longer than snout; one preocular, one or two postoculars; temporals 1+2, widely separated from the postoculars; the sixth, or fifth and sixth labials forming sutures with the parietal; seven supralabials, third and fourth bordering orbit; scales in 17 rows; ventrals 165-173; grooved posterior fangs present.

Upper parts dark grayish-brown; two narrow yellowish lines on each side, one of which runs on the first row of scales; the other originates from a spot on each side of the neck and is continued as a series of elongate, dashlike spots which are almost contiguous; a

* No. 8312 is in M. C. Z., Harvard. Others in U. S. National Museum.

white spot on the antero-lateral part of the parietal; supralabials blackish brown on upper parts, yellowish on lower parts. Venter uniform yellowish.

If the species is not congeneric with *Coniophanes*, it may be necessary to consider this form under a new generic designation.

Coniophanes piceivittis Cope

Coniophanes piceivittis Cope, Proc. American Philos. Soc., vol. 11, July, 1869 (type locality Chihuitán, Oaxaca); Bailey, Michigan Acad. Sci., Arts, Lett., vol. 24, pt. 2, 1938 (1939), p. 31 (Bebedero, Costa Rica).

This species, so far as I am aware has its place in the list of Costa Rican snakes on the basis of a specimen in Vienna * purporting to come from Bebedero, Costa Rica. Unless further specimens are found it might be well to re-examine this specimen to confirm the identification or to question the origin of the specimen. The point nearest to Bebedero, at which the species is definitely known to occur as recorded by Bailey, is nearly 300 mi. north of Costa Rica in the northern part of Honduras!

A diagnosis of the species is given: scale rows 25; a small "subpreocular"; a broad median stripe and a broad lateral dark stripe four or five scales wide, the dark stripes having sharply defined edges; ventrals, males 158-168, females 160-173; subcaudals, males 82-91, females 78-84; scale formula: 21-23-25-17. Anal ridges present in mature males. Eight supralabials, fourth and fifth entering eye; infralabials 10, six touching chinshields; temporals 1 + 2.

Head with a light stripe through top of eye, continuous with the dorsolateral light lines or interrupted on neck. Labials and chin spotted with dark brown or black; body with a black dorsal stripe five to seven scales wide; a black lateral stripe on either side three and two half scales to five and two half scales wide, separated from the dorsal stripe by a narrow dorsolateral light stripe one and two half scales wide. The lower edge of the lateral dark stripe sharply defined contrasting with the light lower rows; lowest two rows faintly flecked with black; belly nearly immaculate.

Coniophanes fissidens punctigularis Cope

Coniophanes punctigularis Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 12, 1860, p. 248 (type locality, Honduras); Smith, Proc. U. S. Nat. Mus., vol. 91, 1941, pp. 107-109, map, fig. 33.

Coniophanes fissidens fissidens (*part.*), Bailey, Michigan Acad. Sci., Arts Letters, vol. 24, pt. 2, 1938 (1939), pp. 14-23, pl. 1, fig. 4.

Two specimens are in the collection from Costa Rica. The following characters obtain: R.C.T. Nos. 872, 1369; sex, ♀, (yg.);

* Bailey (Pap. Michigan Acad. Sci. Arts Lett., vol. 24, pt. 2, 1938 [1939], p. 31) quotes from notes of E. R. Dunn.

loreal quadrangular; preoculars, 2-1, 1-1; postoculars, 2-2, 2-2; temporals, $1 + 2$, $1 + 2$, $1 + 3 + 3$, $1 + \frac{1}{2}$; supralabials, 8-8, 8-8; labials enter eye, 4-5, 4-5; 4-5, 4-5; infralabials, 10-9, 10-9; infralabials touch chinshields, 5-4, 5-5; scale formulae, 21-21-17, 22-21-17. Ventrals 120, 123; subcaudals 46 +, 69; anals, 2, 2.

Color markings very distinct in the young No. 1369 from Los Diamantes, Costa Rica. Above brownish, the median scale row with a black spot in posterior part of each scale so as to simulate a median discontinuous dark line; all scales with slightly darker edges so that a fine, but distinct reticulated pattern is evident; fourth and fifth rows with dark flecks so that a dim lateral or dorsolateral line is evident, the color growing lighter toward ventrals.

Head light brown with some indefinite blackish dots on parietals; labials cream, bordered by a blackish line above; posterior seventh and eighth labials are brown above, the cream covering only their lower fourth (or less); cream area flecked with black; two minute, blackish-bordered, cream ocelli on temporals and a larger one somewhat behind these at same level. At about fifth ventral a black-edged cream line begins on the sixth scale row and continues back. The black border is soon lost and the line can be traced with little difficulty to end of body; chin and entire underside of body light cream peppered with black dots, eight or ten on each ventral; those on outer edge of ventrals largest.

The larger specimen, No. 972, is darker and venter more salmon pink; spot on outer edge of ventrals not larger than the others and may be indistinct or absent; lateral stripe not clearly discernible since all scales are more pigmented; ocelli and light lateral stripe evident, the stripe being only on anterior part of body.

The larger specimen was killed by Richard C. Taylor near San Isidro El General with the same shot that also killed a specimen of *Dryadophis melanolomus alternatus*. Only a single snake had been seen, and consequently there is no data on the behavior of the two species or known reason for the two specimens being so closely approximated.

A specimen in the U. S. National Museum has 115 ventrals and 70 subcaudals.

Known variation in ventrals and subcaudal counts are: ♂ 114-119, subcaudals 70-80; ♀ 121-127, 63-75.

Bailey, *loc. cit.*, has reported the species from the following localities in Costa Rica: Siquirres; El General, Surubres, Suretka, and Palmilla.

Genus RHINOBOTHRYUM Wagler

Rhinobothryum Wagler, Natürliches System der Amphibien, 1830, p. 186.

Genotype: *Rhinobothryum macrorhinum* Wagler.
Only one species is known from Costa Rica.

Rhinobothryum bovallii Andersson

Rhinobothrium bovallii Andersson, Medd. Göteborgs Mus. Zool. Afdel., 9 (Göteborgs Kungl. Vetensk. Vitt. Semh.) Band 17, 1914 (1916), pp. 32-33 (type locality, Siquirrres, Costa Rica).

Rhinobothryum bovallii Dunn and Bailey, Bull. Mus. Comp. Zool., Harvard Coll., vol. 86, 1939, pp. 16-17 (Limón, Costa Rica, and localities in Panamá).

This rare back-fanged snake with grooved teeth may be distinguished by the following characters: rostral large, wedged in between internasals, the portion visible above shorter than its distance from frontal; latter broader than long, much shorter than parietals, much shorter than its distance from tip of snout; loreal longer than high; one preocular, not reaching to upper surface of head; two postoculars; temporals, 2-2; eight supralabials, the fourth and fifth bordering eye; fifth to seventh much higher than others; ten infralabials, four or five touching the anterior chinshields; posterior chinshields about half area of first and separated by two scales, nearly equal to anterior in length; scales in 21 rows, smooth anteriorly, keeled posteriorly on back and on tail; on sides the five outer scale rows are smooth; ventrals 240-246, notched and distinctly angular laterally; anal single; subcaudals (divided) 115. Two posterior teeth of maxilla enlarged, grooved.

Top of head black, the scales outlined with yellow margins, the sides white (red) each scale with a dark spot; a narrow light band on back of head followed by a dark band 12 scales long, not crossing throat; body banded with black or blackish brown and red bands, separated from each other by narrow white bands; in middle of body the red bands cover six or seven up to nine or ten scale-lengths, the dark bands six and the white only two scale-lengths. Red scales all tipped with black; on belly, red becomes white and the dark and white alternate; posterior ventrals have dark spots in areas corresponding to the red color. Five black bands on tail as broad as the red intervening bands. Length 1190 mm.; tail 290 mm.

The species is known from Limón and Siquirres, Costa Rica. I have examined a specimen (Harvard M.C.Z. No. 42790 from Esperanza Ridge, Panamá.

Genus CONOPHIS Peters

Conophis Peters, Monatsb. Akad. Wiss. Berlin, 1860, p. 519.

Genotype: *Conophis vittatus* Peters.

Two species have been reported from Costa Rica. They may be differentiated by the following key.

KEY TO COSTA RICAN SPECIES OF CONOPHIS

Upper labials immaculate; head light with three broad brown stripes; body light, with brown stripes..... *lineatus dunni*

Upper labials with black borders; head black with two white lines; body blackish with two white lines on each side... ..... *nevermanni*

Conophis lineatus dunni Smith

Conophis lineatus Cope (*nec* Duméril and Bibron), U. S. Nat. Mus. Bull., 32, 1887, p. 77 (San José, Costa Rica); Dunn, Copeia, 1937, no. 4, p. 214 (Barranca, Tivives, Esparta, San José and Cartago).

Conophis lineatus similis Smith (*nec* Bocourt), Journ. Washington Acad. Sci., vol. 31, no. 3, Mar. 15, 1941, pp. 123-124.

Conophis lineatus dunni Smith, Proc. U. S. Nat. Mus., vol. 92, 1942, p. 395. (Managua, Nicaragua.)

I have examined a paratype of this form from Esparta, Costa Rica.

Snout projecting, part of rostral visible above, one third to one half its distance from rostral; frontal approximately as long as wide, a little longer than its distance from tip of snout; approximately as long as the parietals; one preocular, not touching frontal; two postoculars; loreal present; temporals 2 + 2; supralabials 8 (7), the fourth and fifth enter eye; infralabials 8-8 to 10-11; temporals 2 + 2 + 3; scale rows 19-19-17; ventrals 169-174; subcaudals 64 ♂, 67-69 ♀.

Chin and labial borders heavily pigmented; a dark stripe along first scale row; lateral dark stripe, passing through eye, restricted to the third and fourth scale rows throughout the length of the body and of solid color (without a broad light median area between the two dark edges); a dark stripe on seventh (or sixth posteriorly) scale rows; no secondary dark stripes on either paravertebral rows or those adjacent to them laterally; second scale row white anteriorly; posteriorly with a dotted secondary line; ends of ventrals pigmented in some parts of body.

Conophis nevermanni Dunn

Conophis nevermanni Dunn, Copeia, 1937, no. 4, pp. 214-215 (type locality, Río Poás de Aserri, Costa Rica).

The type description gives the following data: Scutation similar to *Conophis lineatus*. Scale rows 19-17, smooth, lacking apical pits; nasal divided; preocular one, postoculars two; temporals 2 + 2;

supralabials eight, the fourth and fifth border orbit; infralabials 9 or 10, five touching anterior chinshields; ventrals 179-184 (182 + 2); subcaudals 70.

Black on back and sides, light on venter; a light line from snout continues on sixth scale row; a similar line on second scale row; upper labials edged with black.

Maximum known size, 820 mm.

Reported from type locality and possibly from Bebedero, Costa Rica (see Dunn, *loc. cit.*). The type locality is said to be "a few miles south of San José."

Genus STENORRHINA Duméril

Stenorrhina Duméril, Mém. Acad. Inst. France, vol. 23, 1853, p. 490.

Genotype: *Stenorrhina ventralis* Duméril.

The snakes of this genus may be readily distinguished from other snakes by the fusion of the anterior nasal with the internasal scale.

The material that I have studied leaves some doubt as to the number of recognizable forms of this genus that occurs in Costa Rica. This genus is in need of revision and I believe that Dr. J. Bailey has such a revision under way.

At least three forms appear to be present, which may be distinguished by the following key.

KEY TO FORMS OF STENORRHINA IN COSTA RICA

1. Belly strongly pigmented, each ventral scale with a darker transverse band ..... *d. degenhardtii*
   Belly immaculate cream-white without or with slight trace of pigment; a black temporal stripe present or indicated 2
2. Five lines on body more or less distinct ..... *f. freminvillii*
   No lines on body, scales dark or blackish on bases ..... *d. apiata*

Stenorrhina degenhardtii degenhardtii (Berthold)

Calamaria degenhardtii Berthold, Abhand. Gesell. Wiss. Göttingen, vol. 3, 1846, p. 8, pl. 1, fig. 2, 4 (type locality, Mexico and Central America).

Stenorhina degenhardtii Jan, Arch. Zool. Anat. Fis., vol. 2, 1862, p. 63; Boulenger, Catalogue of the Snakes in the British Museum, vol. 3, 1896, pp. 229-230.

Stenorhina ventralis Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875) p. 141 (Old Harbor, Costa Rica).

Maxillary teeth 15-17, anterior ones small, equal, separated from two enlarged posterior teeth with a groove on outer side. Head not distinct from neck; nostrils between two nasals, the anterior of which is fused with internasals; snout obtusely pointed; rostral broader than deep, the part visible above measuring one half to two thirds of its distance from frontal (rarely equal); internasals about as long as prefrontals or a little shorter; frontal one and one-third to one and one-half times as long as wide, as long as or a little

longer than its distance from snout tip; as long as or a little shorter than parietals; loreal present or absent, if present small; when absent fused to an adjoining scale; prefrontals often touching labials; one preoculars, two postoculars; temporals 1+2, 2+3, or 2+4; seven supralabials, third and fourth enter eye; seven or eight infralabials, three or rarely four labials touching first pair of chinshields, which are longer than posterior pair. Scales in 17-17-17 smooth rows without apical pits; ventrals 158-171; subcaudals 33-36; anal divided; length 750 mm.; tail 100 mm.

A Costa Rican specimen has upper parts brown with more or less distinct darker spots and irregular crossbars; belly more or less black spotted. In one specimen there are no well-defined markings.

Two Costa Rican specimens (Nos. 32582-83) collected by William Gabb are in the U. S. National Museum collection. Both are now very soft but the dark ventral coloration is distinct in both. No. 32582 has 159 ventrals, 33 subcaudals.

Stenorrhina degenhardtii apiata Cope

Stenorhina d[egenhardtii] apiata Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875), p. 142 (El Barrio, Oaxaca).

This subspecies is included in the Fauna of Costa Rica on the basis of a specimen in the U. S. National Museum (No. 9774) collected by Zeledón in "Costa Rica," no specific locality known.

The general characters of this form are as follows: rostral large, more than half its surface visible from above, equal to about three fourths its distance from frontal; internasal fused with the nasal; posterior part of the combined scale elongated; frontal six-sided, elongate; nearly a third longer than its distance from snout tip; a large preocular, 1½ times as high as long; two postoculars; temporals 1-2; 7-7 supralabials, the third and fourth enter orbit; first chinshields larger than second, and tending to separate the second pair for some distance; scale rows 17-17-17, the count around posterior part of head, 24; ventrals 174, subcaudals 36.

The specimen is nearly uniformly colored, each scale with a darker basal spot or area; belly immaculate cream; labials cream except for a black line that crosses side of head.

Stenorrhina freminvillii freminvillii Duméril, Bibron and Duméril

Stenorhina freminvillii Duméril, Bibron and Duméril, Erpétologie Générale, vol. 7, pt. 2, 1854, pp. 868-869, pl. 70, fig. 1, 2 (Mexico).

Stenorrhina freminvillii freminvillii Smith, Proc. U. S. Nat. Mus., vol. 93, 1943, p. 472.

A single specimen, Harvard M. C. Z. No. 15294, from Costa Rica is referred to this subspecies.

The part of rostral visible above large; internasal fused to nasal; a small loreal present; one preocular, two postoculars; temporals 1-2; supralabials 7-7; infralabials 7-7, three labials touching the anterior chinshields; second chinshields small, less than half of first; mental very narrow; ventrals 182, subcaudals 38; anal divided; scale rows 17-17-17 without apical pits.

Head brown with some black spotting; labials cream save on their upper edges, which have a dark longitudinal mark. Body brownish with 5 indistinct dotted lines on back; venter immaculate cream.

Genus SCOLECOPHIS Fitzinger

Scolecophis Fitzinger, Systema Reptilium, 1843, p. 25.

Genotype: *Calamaria atrocincta* Schlegel.

A single species is known from Costa Rica.

Scolecophis atrocinctus (Schlegel)

Calamaria atrocinctus Schlegel, Essai sur la Physionomie des Serpents, vol. 2, 1837, p. 47.
Scolecophis atrocinctus Cope, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 259.
?Pseudoboa petola Picado, Serpientes Venenosas de Costa Rica, 1931, pp. 33-34, fig. 9 (right).

The species has a range extending from Honduras to Costa Rica. I have examined a single male specimen from Costa Rica now in the U. S. National Museum, collected by Zeledón.

Rostral narrowly visible above; internasals small, their length in prefrontal length about 2½ times; frontal distinctly longer than its distance to the end of snout; parietals large, one fourth longer than their distance to snout tip; nasal divided; a small loreal, nearly square; one preocular; two postoculars; temporals 1+1; supralabials 7-7; anterior chinshields twice size of second pair; eye small, its diameter twice in distance to anterior edge of rostral; temporals 1+1+2; ventrals 191; anal divided; subcaudals 53; scales 15-15-15, smooth with a single, very small, apical pit.

Body ringed in black and yellow (white in preservation). On the dorsum the black transverse rings cover 3½ to 4 scale rows, the yellow, 2 to 2½ rows; on venter the white occupies two ventrals, the black three ventrals; head blackish with a band across snout chiefly on the prefrontals, first two labials and the anterior edge of frontals; a triangular white spot from the labials reaching above eye level involving all of fifth and parts of adjoining labials; tip of chin black to the middle of the first chinshields; a small black round spot at the beginning of the throat; first white neck band two scales wide followed by a black band five scales wide; a total of 36 black bands on body, two on head and seven on tail.

The maxillary teeth 14, with two posterior small grooved fangs; eight anterior maxillary teeth grooved laterally (perhaps all maxillary teeth are so grooved since the six following teeth are missing).

Genus TANTILLA Baird and Girard

Tantilla Baird and Girard, Catalogue of North American Reptiles, 1853, p. 132.

Genotype: *Tantilla coronata* Baird and Girard.

Six species are regarded as occurring in Costa Rica. They may be differentiated by the following key.

KEY TO COSTA RICAN SPECIES OF TANTILLA

1. Body reddish brown, with narrow black-bordered cream lines from middorsal line to ventrals, usually alternating; first labials touch or are separated; ventrals 148-155; subcaudals 60-65 ..... *annulata*
   Body not so marked with transverse bars 2
2. Body brownish or reddish; head and part of neck brown followed by a narrow white collar severed medially by a longitudinal median black line; white on venter; nasal separated from preocular or not; ventrals 159-171; subcaudals 44-52 .. *armillata*
   Body not so marked 3
3. Three longitudinal black-edged strips on body; frontal pentagonal; first pair of lower labials separated (rarely touch) bringing mental and first chinshields together; chestnut brown, the scales darker on edges; a pale collar across back of head; ventrals 148; subcaudals 67 ..... *reticulata*
   Not so marked 4
4. Nasal undivided (rarely partly divided); ventrals 180; subcaudals 71; grayish above with a white collar; two black-edged dorsal brown stripes and one lateral run length of body; sometimes a dark line on each side of venter; below white, *virgata*
5. Only a single pair of chinshields; first infralabials in contact; ventrals 146; subcaudals?; light brown above, yellow below; a median brownish stripe and a narrow yellow stripe on adjacent borders of the third and fourth scale rows, bounded above by a single dark brown row, and below by several rows with dark centers; black spot below eye ..... *ruficeps*
   Two pairs of chinshields; first lower labials separated; ventrals 121-135; subcaudals 38; above grayish brown, with an indistinct lighter collar across parietals; no white spots on head ..... *shistosa*

Tantilla annulata Boettger

Plate XVIII

Tantilla annulata Boettger, Zool. Anz., 1892, p. 419 (type locality, Nicaragua); Dunn, Proc. Acad. Nat. Sci. Philadelphia, vol. 92, 1940, p. 119; Dunn and Bailey, Bull. Mus. Comp. Zool. Harvard Coll., vol. 86, Oct. 1939, p. 19 (between Peralta and Turrialba, Costa Rica).

Tantilla semicinctum Barbour and Amaral, Bull. Antiv. Inst. Amer., vol. 1, no. 4, 1928, p. 100 (*fide* Dunn) (Not of Duméril, Bibron and Duméril).

Homalocranium annulatum Günther, Biologia Centrali-Americana, 1895, p. 150 (description of type specimen); Boulenger, Catalogue of the Snakes in the British Museum, ed. 2, 1896, p. 217; Werner, Mitt. Naturh. Mus. Hamburg, Jahrg. 26, 1909, pp. 238-239, fig. 11.

A single specimen (M.N.H. No. 25705) of this rare form was obtained at Turrialba, July 17, 1947. Its characters are given in detail since it differs from the type in certain points.

Rostral distinctly wider than high, part visible above as wide as an internasal, angular posteriorly; internasals half as long as prefrontals; frontal hexagonal, about one-sixth longer than wide, the

lateral angles extremely obtuse, its length about one fourth greater than its distance from tip of snout, its width less than twice that of

PLATE XVIII. *Tantilla annulata* Boettger, MNH No. 25705, Turrialba, Costa Rica, July 17, 1947; 502 mm.

posterior ends of supraoculars; parietals large, their length very slightly less than their distance from tip of snout; nostril between two nasals, which are narrowed at point of mutual contact, the posterior smaller, in contact with the preocular; no loreal; one

preocular; two postoculars, the lower smaller; temporals 1 + 1 + 1 (on left side the two posterior are partially fused); supralabials, 7-7, in the following order of size: 1, 3, 2, 5, 4, 6, 7; infralabials 6-6, in the following order of size: 2, 6, 1, 3, 5, 4, the first four touch chinshields; first pair of labials separated, leaving the very large mental in contact with first chinshields, which are double the size of the second pair; latter narrowly in contact (in the type the first infralabials are in contact, and the mental is separated from the first chinshields).

Scale formula: 15-15-15, the scales smooth with a single minute pit on most of the dorsal scales, situated some distance in from the posterior median border,* visible under magnification, ventrals, 148, separated from the posterior chinshields by one scale; subcaudals 59 + 1; anal divided.

Snout yellowish white (the rostral somewhat grayish), the color extending to mouth, and posteriorly to middle of prefrontals; this followed by a broad black band, which extends back to posterior tips of parietals, and laterally across upper and lower labials to chinshields; a white spot covering fifth upper and fifth lower labials as well as edges of adjoining scales; remainder of chin white; a narrow yellowish band, one scale wide, crosses extreme posterior parts of parietals and adjoining scale row, interrupted mesially by a single black scale; this band followed by a broad black-brown nuchal band at least six transverse scale-rows wide and bordered behind by another narrow yellowish band; this in turn bordered by a blackish band two scales wide. General body color following this is reddish brown, to brown lower on sides, the median part of each scale slightly darker than the outer parts, thus leaving an impression of very faint longitudinal lines on each scale row (a little more evident posteriorly); a series of yellow vertical blotches the width of a scale length and bordered laterally by black of nearly same width, reach to middorsal line, alternating (usually) with a similar series on opposite side; these yellow and black spots separated usually by eight to ten scales. Dorsal coloration encroaches on ventrals so that outer fourth of ventrals colored like sides; a few scattered dark flecks on median part of ventrals; median part of venter and subcaudal region salmon to coral red; yellow bands tend to widen somewhat low on sides; there are 12 or 13 of these on body, five or six on tail. Maxillary teeth, 20, sub-

* The presence of these minute "pits" has been noted by me in certain other species of *Tantilla*. I am uncertain whether or not these are homologous with the one, two or four "apical" pits that may occur on other snakes.

equal, followed, after a slight diastema, by two smaller grooved fangs; 25-26 mandibular teeth.

Total length, 502 mm.; tail, 108 mm.; snout to vent, 394 mm.; width of head, 10.2.; length of head, 15 mm.; width of body, 11.5 mm.

The above description differs somewhat from the brief description of the type. In that specimen, the markings are confined to the anterior third of the body, and the ventral color is yellow (faded?) instead of red.

From a young specimen described by Dunn (*loc. cit.*), the Costa Rican specimen, while agreeing in the general pattern, differs much in color and in having the first labials separated. In Dunn's specimen the ventrals are 155, subcaudals, 65. There are 13 marks on each side of body; six on tail.

A specimen reported by Werner, *op. cit.*, agrees in much better detail with my specimen, both as regards squamation and color pattern. This specimen is 590 mm. in length; ventrals 149; subcaudals 59 + 1. No locality data are given.

Dunn and Bailey (*loc. cit.*), report a specimen from between Peralta and Turrialba, Costa Rica. This has 151 ventrals; subcaudal count not given (perhaps a defective tail).

Tantilla armillata Cope

Tantilla armillatum Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875), p. 143 (type locality, middle Costa Rica).
Tantilla melanocephalum var. Cope, Proc. Acad. Nat. Sci. Philadelphia, 1871, p. 205.
Homalocranium armillatum Günther, Biologia Centrali-Americana; Reptilia and Batrachia, 1895, p. 149, pl. 52, fig. C (Cartago, Costa Rica).

Slender, small snake with scales in 15 rows; head flat, depressed; eye less than half the length of the snout; length of prefrontals three times the length of internasals; frontal wide, much shorter than the parietals; one preocular, two postoculars; nasals notched slightly below, the posterior touching the preocular (or narrowly separated from it by the prefrontal); temporals 1 + 1 + 2; seven supralabials, the seventh much the largest; six infralabials, the first pair form a suture behind the mental, first four touch first chinshield, the fourth also touching second pair of chinshields. Ventrals 159-171; anal divided; subcaudals 44-52.

Above chocolate-brown, head and nape for five scales black, with a yellow spot on end of muzzle, one on posterior part of each parietal plate, two on lip behind eye, and one below each nostril; the black is bordered posteriorly by a yellow collar of two scales length, which is also bordered by black behind except where it sends off on the third and fourth rows of scales on each side a

narrow light band which extends to tail. Below this, and also on median scale row, is a narrow line of brown. Below immaculate white; total length as given by Günther, eight and three-fourths inches.

I have examined two Costa Rican specimens of this species as follows: Harvard M.C.Z. No. 15285 from Surubres (Surubreo), Costa Rica has a ventral count of 174, the subcaudals defective. The head and neck, for six scale rows back of parietals, generally black with some cream spots followed by a cream band two scales wide; a discontinuous band forming four spots, one on last labials, one covering parts of back end of parietal and temporal; two small yellow spots on extreme anterior part of parietals; a spot on back edge of rostral and internasals; a spot covering parts of first and second labials, and a spot on fifth labial; venter immaculate, light lateral band present.

A specimen in the U. S. National Museum (No. 9787) from "Costa Rica" has 169 ventrals, 47 subcaudals. The head spotting differs somewhat in detail from that described above; a light stripe follows the third and fourth scale rows to tail; a row of dark dots follows the first scale row.

It may eventually be necessary to regard this form as a subspecies of *Tantilla melanocephala*, but I lack necessary material to establish this.

Tantilla reticulata Cope

T[antilla] reticulata Cope, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 77 (type locality, Coyucas de Veragua, New Grenada).

Rostral broad, visible from above; nasal divided, the nostril chiefly in prenasal; postnasal touching first two supralabials, preocular, internasals, and prefrontals; one preocular, two postoculars; temporals $1 + 1 + 1$; frontal plate broad, angular in front, projecting posteriorly for half its length between parietals; supralabials seven, last largest, third and fourth border the orbit; anterior chinshields touch mental separating first pair infralabials; scales in 15 rows; ventrals 148, anal divided; subcaudals 67.

Color chestnut brown above, much darker posteriorly than anteriorly, the color extending upon the edges of the ventrals; anteriorly the scales have somewhat darkened edges, presenting a reticulated appearance; median dorsal row of scales lighter, forming a pale line which disappears on tail; third and fourth rows on each side lighter, forming indistinct lines; a pale yellow-brown collar crosses posterior parts of parietals; head scales clouded and edged

with darker; a deep brown mark extending from parietals to the mouth across the yellowish labials; on under side pale yellow, deepening posteriorly.

I have examined a specimen from Reventazón (river?), Costa Rica (Harvard M. C. Z. No. 15266). The detail of the color pattern follows: A brown line on first scale row and ventral edge; a cream line covering upper edge of first row and part of second; a brown line covering upper half of second and one half of third; a cream line on upper half of third, fourth and lower half of fifth rows; a brown line on upper half of fifth; a cream line on sixth row; lower part of seventh row dark; a median light stripe on middorsal row and upper part of seventh scale row. The nuchal cream band is interrupted mesially; head dark with a white spot on snout, and one on first labials; a black spot below eye; brown flecks on several of the infralabials; venter immaculate yellow or whitish; ventrals 176; subcaudals 66.

Tantilla virgata (Günther)

Microdromus virgatus Günther, Ann. Mag. Nat. Hist., ser. 4, vol. 9, 1873, p. 17, pl. 4, fig. B (type locality, Cartago, Costa Rica, four cotypes).

Homalocranium virgatum Bocourt, Etudes sur les reptiles; Mission Scientifique au Mexique . . . , livr. 9, 1883, p. 584, pl. 36, fig. 4; Günther, Biologia Centrali-Americana, Reptilia and Batrachia, 1895, p. 154, pl. 52, fig. A; Boulenger, Catalogue of the Snakes in the British Museum, vol 3, 1896, p. 223.

Homalocranium sexfasciatum Fischer, Abhandl. d. naturw. Verein, Bremen, Bd. 7, 1882, pp. 225-226, pl. 14, figs. 8-10 (Costa Rica).

Tantilla sexfasciata Cope, Bull. U. S. Nat. Mus. no. 32, 1887, p. 83.

Tantilla virgata Cope, Bull. U. S. Nat. Mus., no. 32, 1887, p. 84.

Nasal usually undivided; rostral just reaching upper surface of snout; internasals a little less than half of the prefrontals; frontal five-sided, longer than broad; parietals as long as their distance to rostral; nasal not or but slightly in contact with preocular; one preocular, two postoculars; seven supralabials, third and fourth border orbit; temporals 1 + 1; first pair of infralabials separated or narrowly in contact; anterior chinshields large; posterior small, scalelike; ventrals 154-175, subcaudals 57-71; scales in 15-15-15 rows; total length 315 mm.; tail 75 mm.

Upper parts grayish or yellowish brown; a white collar present; three or four stripes on each side of body; a pair of brown bands edged with black two scales broad, run from collar to middle of tail; a similar band along each side of body, and sometimes a narrow blackish line along each side of abdomen. Lower parts uniform yellowish white. Upper labials white, with a black spot below eye and on rostral shield.

Known from Cartago, Costa Rica.

Tantilla schistosa (Bocourt)

Homalocranion schistosum Bocourt, Etudes sur les reptiles; Mission scientifique au Mexique et dans l'Amérique Centrale, livr. 9, 1883, p. 584, pl. 36, figs. 10, 10a-10e (type locality, Haute Verapaz, Guatemala).

Tantilla schistosa Cope, U. S. Nat. Mus. Bull., no. 32, 1887, p. 83; Dunn and Bailey, Bull Mus. Comp. Zool., Harvard College, 1939, pp. 5, 19 (Altos de Cangrejal, near San José, C. R.).

A specimen of this Tantilla (M. N. H. No. 25731) was captured along the Reventazón River at Turrialba, under a log where also was obtained a *Micrurus nigrocinctus mosquitensis*. The *Tantilla* was placed in the same container with the *Micrurus*, but on returning to the laboratory, it was missing and was later discovered in the stomach of the *Micrurus*. Digestive fluids have injured the specimen so that accurate identification is impossible. The following miscellaneous characters can be discerned, however, and the species appears to be very close, if not identical, to Bocourt's *schistosa*.

Part of rostral visible above smaller than internasals; latter scales about one half length of prefrontals, which are broader than long; frontal hexagonal, about one-third longer than its distance from end of snout, one-fourth longer than wide, the front border forming a very obtuse angle; parietals about one-fifth longer than their distance from end of snout; scale rows 15-15-15.

The character of the scales on the sides of the head and the lips cannot be determined with certainty; the first pair of labials are separated, the large anterior chinshields touching the mental. A light yellowish band crosses the neck and encroaches on the posterior part of the parietals. Olive above (becoming brown in preservatives), each scale with a lighter center and a darker outer border, thus giving a geometrically reticulated pattern (which is distinct if the specimen is submerged in water). Chin and throat bluish white; anterior one fourth of body dull creamy white gradually becoming, first dimly, then strongly, salmon pink; edges of ventrals lighter; under side of tail uniform salmon pink.

A specimen in Harvard M. C. Z. (No. 15302) is from Altos del Cangrejal, Costa Rica. The following scale characters obtain: ventrals 140; subcaudals 29; one preocular; two postoculars; temporals 1+1; seven upper labials, the third and fourth border orbit; five infralabials, three touching first chinshields. Generally brown above, the scale edges a little darker.

Tantilla ruficeps (Cope)

Poganaspis ruficeps Cope, Proc. Acad. Nat. Sci. Philadelphia, 1894, p. 204 (type locality, Costa Rica).
Tantilla ruficeps Amaral, Mem. Inst. Butantan, vol. 4, 1929, p. 221 (Costa Rica).

Rostral visible from above; frontal rather long, hexagonal; nostril between two nasals, the posterior separated from preocular by prefrontal; one preocular, two postoculars; temporals 1-1; seven supralabials, the third and fourth bordering orbit; first infralabials in contact behind mental; a single pair of chinshields touching four lower labials. Ventrals 146; anal divided.

Light brown above; median dorsal row of scales deep brown; a narrow yellow line on adjacent borders of third and fourth rows of scales which is bounded above by a dark brown line; upper surface of head reddish brown, with a pale spot at end of each parietal shield; upper lip yellow, and a black spot below the eye; lower parts yellow. Length 223 mm.

The species presumably is known from the type specimen only.

FAMILY HYDROPHIIDAE

A single genus representing this marine serpent family has reached the Western Hemisphere. It is distributed along the western coast from California to Chile.

Genus PELAMIS Daudin

Pelamis Daudin, Histoire naturelle . . . des Reptiles, vol. 7, year XI, (?1803), pp. 357-362.

Genotype: *Anguis platura* Linnaeus.

One species is known from the Pacific coastal waters.

Pelamis platurus (Linnaeus)

Hydrus bicolor Schneider, Historiae Amphibiorum naturalis et literariae, Fasc. Primus, 1799, p. 242 (type locality, Pine Island, Pacific Ocean).
Pelamis bicolor Picado, Serpientes venenosas de Costa Rica, 1931, pp. 23-27, fig. 6 (Costa Rica).
Pelamis platurus Gray, Ann. Philos., 1825, p. 15.

This marine serpent, the only species known on the American coasts, has been reported for the Pacific coast of Costa Rica, where it is reputed to be abundant. The high, compressed type of tail is found on no other American snake. This serpent may be recognized by the following characters: upper half of body blackish, lower half dirty white or yellowish, the two separated by a narrow cream line; posterior part of body somewhat spotted; tail yellow with a number of black spots.

The tail strongly compressed into an "oar" about 10 times as high as wide. Scales on median ventral surface of body and tail about

size of dorsal scales. Frontal as long as its distance from tip of snout, nearly equal to a parietal; nostril in nasal directed dorsally; one preocular, two or three postoculars; temporals numerous; seven to nine supralabials, the fourth or fourth and fifth entering orbit. Scales 45-57 about middle of body, smooth in young and females, with one to three tubercles in males. The species reaches a length of three feet.

I have examined the following Costa Rican specimen: U. S. N. M. No. 37490. Some of the characteristics of this specimen are: scale formula, 42-47-49-35; temporals 2+2+3+4; supralabials 9-9; ventrals 295, preceded by 13 scales between chinshields and first distinguishable ventral; 49 subcaudals; 16 dorsal scale rows black; next four cream, remainder dirty white or light tan; spots tend to form dorsal and ventral rows on tail which tend to dovetail with some yellow color between.

U. S. N. M. Nos. 96038, 96040, 96041, Port "Parlear," Costa Rica:

No. 96038. Scale formula, 41-46-47-33; scales with two or three tubercles, sometimes absent on dorsal scales; rostral partly divided by a suture; 8-9 supralabials; ventrals 340; subcaudals 43.

No. 96040. Scale formula, 42-46-47-35; 9-9 supralabials; temportals 2+2+3+4; an elongate subocular; ventrals 320; subcaudals 48.

No. 96041. Scale formula, 42-46-49-37; ventrals 320, subcaudals 41; 7-7 upper labials; 11-11 infralabials; temporals 2+2+3+4; one subocular on one side.

FAMILY ELAPIDAE

Only a single genus, *Micrurus*, is known to occur in Costa Rica.

Genus MICRURUS Wagler

Micrurus Wagler, *in* Spix, Serpentium Brasiliensium . . . , 1825, p. 48.

Genotype: *Micrurus spixi* Wagler.

Four species and six forms are known to occur in Costa Rica. They may be recognized by the following key.

KEY TO FORMS OF MICRURUS IN COSTA RICA

1. Two-color species, black and red (pink or whitish); long, moderately slender snakes; ventrals 269; subcaudals 26; 62 dark black bands on body, four on tail ..... *mipartitus multifasciatus*
   Three-color species, black, yellow (cream), red 2
2. Subcaudals more than 50 (53-58); ventrals 192-199; 13-16 black rings on body; 7-9 on tail; no keeled supra-anals ..... *clarki*
   Subcaudals less than 50 3
3. Seventeen or more black rings on body 4
   Sixteen or less rings on body 5

4. Body slender; 18 body rings, 4 on tail; ventrals ♂ 241; subcaudals 32; keeled supra-anal scales ..... *alleni richardi*
   Body thicker; 22 body rings, 5 or 6 on tail; ventrals ♀ 215; subcaudals ♀ 40 ..... *pachecoi*
5. Black rings 10-12 on body; 3-5 on tail, usually totaling 15; ventrals ♂ 189-193; ♀ 208-210; subcaudals ♂ 47-49; ♀ 35; length 698 mm. *nigrocinctus mosquitensis*
   Black rings 16 on body; 5 on tail; ♂ ventrals 194-204, subcaudals 47-48; ♀ ventrals 214-218; subcaudals 34-36; length 596 mm. ..... *nigrocinctus nigrocinctus*

Micrurus mipartitus multifasciatus (Jan)

Plate XIX

Elaps multifasciatus Jan, Rev. Mag. Zool., 1858, p. 521; Günther, Ann. Mag. Nat. Hist., ser. 4, vol. 9, 1872, p. 36; and Biologia Centrali-Americana, Reptilia and Batrachia, 1895, p. 184.

Elaps mipartitus Picado, Serpientes venenosas de Costa Rica, 1931, p. 32 fig. 9 (*non* Duméril, Bibron and Duméril).

Only a single specimen (M.N.H. No. 25187) of this large red and black banded coral snake is in the material at hand. It was found at Turrialba on the I.A.I.A. farm in trash, Aug. 1, 1947. The specimen furnishes the following data: head rather flat, not, or scarcely, distinct from neck; eye diminutive, its greatest diameter (two mm.) about four times in distance from eye to end of snout, and about two and two-tenths times in its distance from edge of upper lip. Rostral broader than deep, part visible from above shorter than internasals; latter scales less than half length of prefrontals; frontal scale narrow but at least one-third wider than supraocular, its length equal to its distance from middle of internasals; parietals large, their length equal to their distance from rostral; nasal divided; loreal longer than wide, bordering eye and forming a broad suture with supraocular; no preocular present; two postoculars; temporals 1 + 1 (1 + 2), the anterior not especially narrow; seven supralabials, third and fourth very high entering orbit, in following ascending order of size: 1, 2, 4, 5, 7, 3, 6; infralabials seven, four normally touching first chinshields, which are a little broader but about same length as second pair (scales on right side of chin region abnormal due to injury).

Scale rows 15-15-15; ventrals, 269; anal divided; subcaudals, 26, the fourth and fifth undivided; 62 dark bands on body, four on tail with extreme tip black, and deflected downward.

Picado (*loc. cit.*,) reports a total length of 1130 mm. for the species.

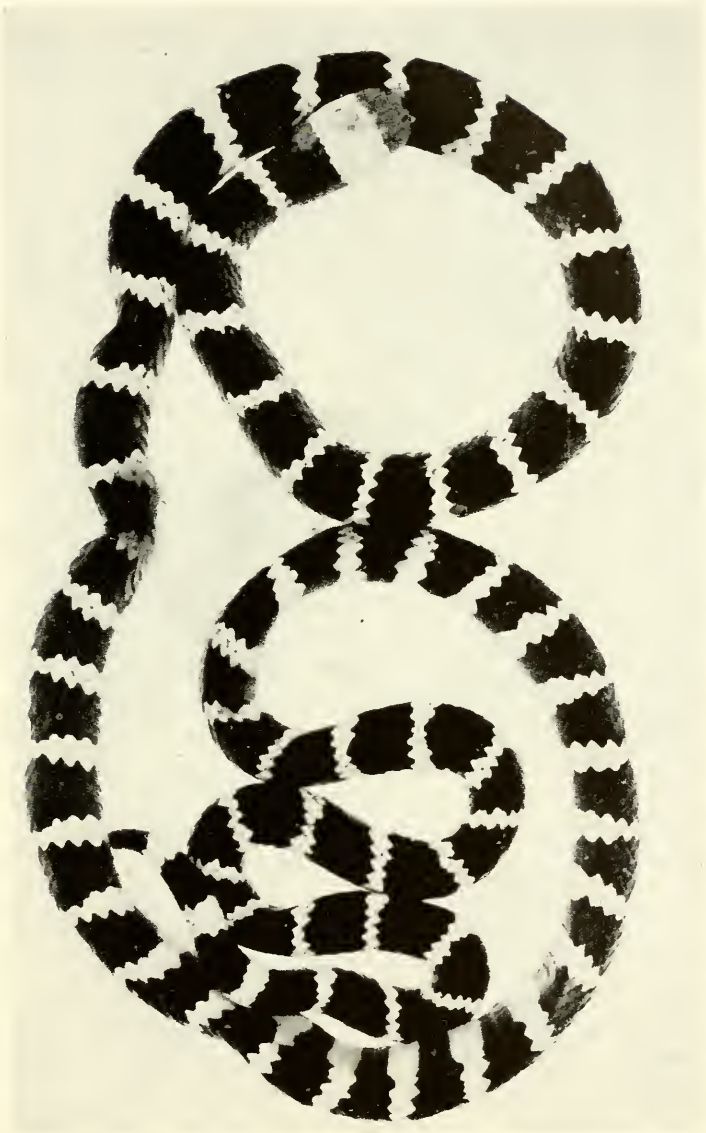


PLATE XIX. *Micrurus mipartitus multifasciatus* (Jan), MNH No. 25187, Turrialba, Costa Rica, August 1, 1947.

Micrurus nigrocinctus nigrocinctus (Girard)

Plate XX

Elaps nigrocinctus Girard, Proc. Acad. Nat. Sci. Philadelphia, 1854, p. 226, and U. S. Naval and Astronomical Expedition, vol. 2, Zoology, 1855, p. 210, pl. 35 (type locality, Taboga Island, Bay of Panamá).

Micrurus nigrocinctus nigrocinctus Schmidt, Smithsonian Misc. Coll., vol. 89, no. 1, Mar. 16, 1933, p. 18 (Panamá localities); Zool. Ser. Field Mus. Nat. Hist., vol. 20, Dec. 11, 1933, p. 33 (Panamá Canal Zone, southwestern Panamá, Pacific slope of Costa Rica, and Nicaragua); Dunn, Notulae Naturae, no. 108, 1942, p. 8 (Boruca, Buenos Ayres, Costa Rica. One of these, Amer. Mus. Nat. Hist. No. 17365, served as a paratype for *n. mosquitensis* Schmidt).

Schmidt gives the following range of scales in a series from Panamá: Ventrals and subcaudals respectively, males 194, 196, 204; 47, 47, 48, with totals 241, 243, 245. For females, 214, 215, 215, 218; 34, 36, 36, 35, with totals 248, 251, 251, 253.

A specimen M. N. H. No. 25190 taken on the Pacific slope of Cerro de la Muerte at Boquete Camp is referred to this species. The ventrals are 207, the subcaudals 55, totaling 262, of which the third to tenth are undivided. There are 16 black bands on the body, and five on the tail.

Scale characters of this specimen are as follows: part of rostral visible above nearly equal in length to median internasal suture, much wider than high; length of internasals equal to two thirds length of prefrontals; latter scales one fifth wider than long, forming an acute angle laterally; *frontal nearly double width of supraoculars which are narrowed posteriorly*, the widest part being near the anterior end; eye very small, 3½ times in its distance from end of snout; frontal at least one fourth longer than its distance from the end of snout; one fifth shorter than parietals; length of latter equal to their distance from rostral; nasal divided; loreal as high as long, forming equal contacts with eye and supraocular; two postoculars; temporals $1 + 1 + 2$, the upper tertiary largest; seven supralabials; seven infralabials, three in contact with first chinshields which are about one fourth shorter than second pair.

Scales smooth save that the lateral scales in front of anus and four lateral caudal rows are distinctly keeled, as is the outer edge of the first subcaudals. Scale formula 15-15-15; ventrals 207; anal divided; 55 subcaudals, of which the third to tenth are undivided.

Tip of snout black, the color covering first three labials and upper part of fourth, the supraoculars, frontal, and a narrow margin of parietals that border frontals. There are 16 black bands on body, their width equal to four scale lengths; anterior edges of black bands straight, posterior edge dentate; on each side a yellow band two

PLATE XX. *Micrurus nigrocinctus nigrocinctus* (Girard), M.N.H. No. 25190, Boquete Camp on Pan-American Highway, Pacific slope, Cerro de la Muerte; total length, 596 mm.

scales wide borders the black; red bands between yellow bands, all scales of which have a black spot; on ventral surface body bands occupy two or three ventral scales, the red and yellow, eight to eleven; there are five black bands on tail, each the width of five or six subcaudals.

Usually on each of the ventral red areas there is a single small black fleck. The yellowish band on the back of the head terminates one scale row back of the parietals; it is continuous under chin, covering all of it save the anterior portions of the first three infralabials. Total length, 596 mm.; snout to vent, 502 mm.; tail, 94 mm.

This specimen differs from other Costa Rican and Panamanian specimens that I have examined in having several of the subcaudals single.

The type specimens of *Elaps nigrocinctus* Girard * were collected on Taboga Island, Bay of Panamá, Panamá, by Lieut. J. M. Gilliss. The two specimens are U. S. N. M. No. 7347 (2 specimens), the larger ♀ (figured) and a smaller ♀ cotype. The figured specimen has 16 body bands (including the nuchal) and four on tail, the terminal band being very small. The yellow borders of the black bands are scarcely indicated in the larger cotype, but the smaller specimen has one or one and one-half scale rows of yellow bordering the black bands. The smaller specimen has 14 bands on neck and body, four on tail. The ventral counts of the two specimens are respectively 213 ventrals, 36 + 1 subcaudals; 214 ventrals, 35 subcaudals. Girard reports 217 + 1 ventrals (probably counting the small scales on chin posterior to chinshields); subcaudals 18. The latter figure is an error probably for 38 which would be correct if the small scale lateral to the anal is counted. Total length, 760 mm.; tail, 72 mm.

The mainland specimens of *nigrocinctus* agree fairly well with the small Taboga Island form although there is usually a somewhat larger number of body bands (15 to 17) and the ventral count is higher, the subcaudal count lower; however, the total ventral-subcaudal counts are 244-256, similar to the total in the types. This variation may represent merely a sex difference.

* Proc. Acad. Nat. Sci. Philadelphia, vol. 7, 1854, p. 226; and U. S. N. and Astro Exped., vol. 2, Zool. 1855, pl. 35, figs. 1-6.

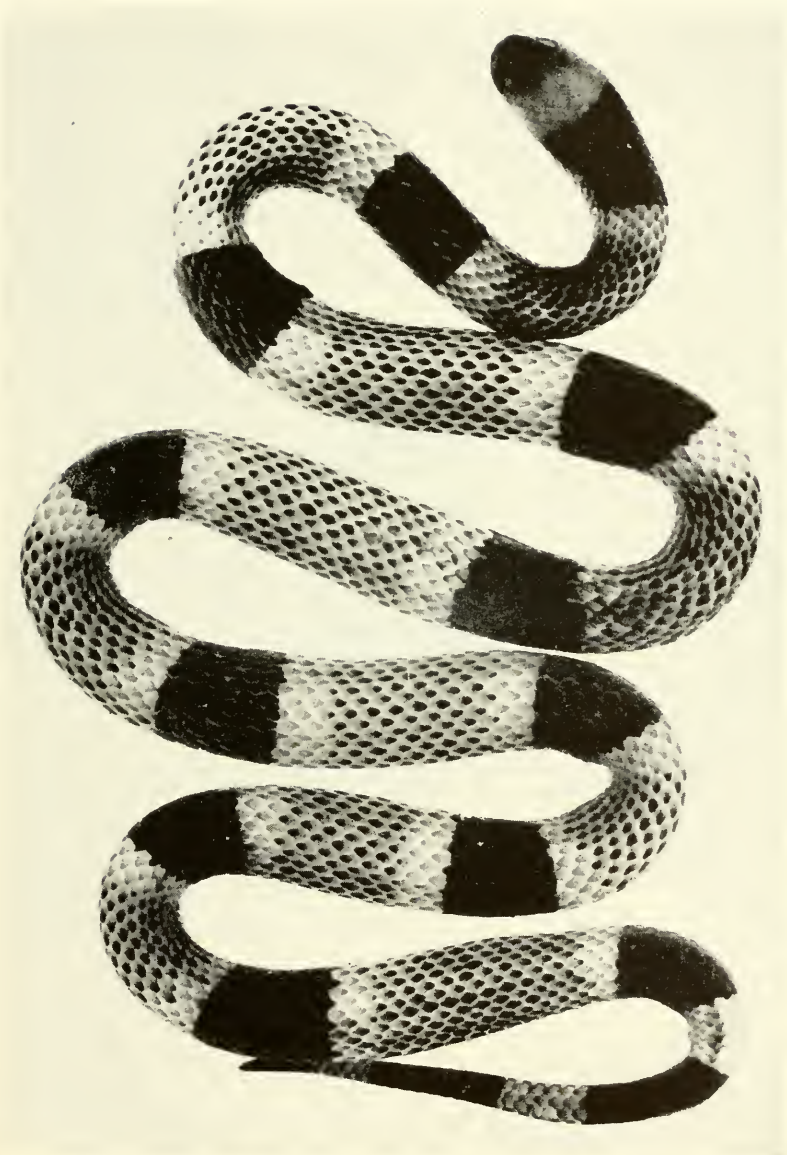


PLATE XXI. *Micrurus nigrocinctus mosquitensis* Schmidt, RCT No. 471, La Suiza, July 15, 1947; about natural size.

Micrurus nigrocinctus mosquitensis Schmidt

Plate XXI, text fig. 5

Micrurus nigrocinctus mosquitensis Schmidt, Zool. Ser. Field Mus. Nat. Hist., vol. 20, 1933, p. 33 (type locality, Limón, Costa Rica).

Elaps fulvius Picado, Serpientes Venenosas de Costa Rica, 1931, pp. 28-29, fig. 8 (left) (non *Elaps fulvius* [Linnaeus]).

Five specimens of this species were collected in the Caribbean drainage of Costa Rica. Two are from the lowlands (elevation less than 900 ft.) at Los Diamantes, one mile south of Guápiles (RCT no. 1442, MNH no. 25191). Two were taken at Turrialba (RCT no. 15, MNH no. 25166), and one at La Suiza, five to six miles southwest of Turrialba (RCT no. 471). This series of specimens agrees in general in the following color characters:

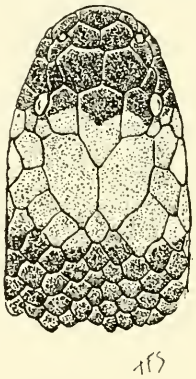


FIG. 5. *Micrurus nigrocinctus mosquitensis* Schmidt, RCT No. 471. La Suiza, Costa Rica. Head dorsal view $\times 3$.

Anterior part of head black, this color reaching back and including most of supraoculars, entire frontal, most of fourth supralabial, and a narrow black stripe behind eye on postoculars; a light yellowish band crossing back of head reaches one scale-length back of parietals, passes under chin to near median ventral line, where it is interrupted by a black or blackish longitudinal stripe connecting blackish area on front of chin with first black neck band. Paired chinshields are black with some light flecks.

Body with 10-12 bands varying in length from six to nine scale-lengths. Anterior edge of each band straight, posterior edge dentate; yellow bands bordering black, washed with brownish fawn, their length equal to three scale-lengths. Intervening spaces dull red above, orange or tomato-red below; each scale with a very distinct black spot often covering more than half its area; red

ventrals have small black flecks or blotches. On venter, black bands have a length of six ventrals on anterior part, and five ventrals on posterior part of body; each black band bordered by immaculate yellow for a width of two ventrals. Tail with from three to five bands, having a length of nine or ten scales, and covering nine or ten pairs of subcaudals ventrally except where the last black spot is terminal in which case band may be small.

The two Turrialba specimens, from elevations of 1750 and 1950 ft. have practically no dark blotching or spotting on the ventrals and all caudal red bands lack many of the black spots on the dorsal and lateral scales. The yellow head band is dim but in those from near Turrialba the area is suffused with smoky fawn.

The figure given (pl. XXI) shows the general characteristics of the form, particularly the wide yellow bands bordering the black.

I have examined the type and certain paratypes* of *mosquitensis*.

SCALE DATA ON MICRURUS NIGROCINCTUS MOSQUITENSIS

No.	Sex	Ventrals	Subcaudals	Total	Black bands body and tail	Supralabials	Infralabials
15	♂	189	47	236	11 + 4	7–7	6–6
471	♀	210	35	245	12 + 3	7–7	6–6
1442	♀	208	35	243	12 + 3	7–7	6–6
25166	♂	(192)*	48	240	10 + 5	7–7	6–6
25191	♂	193	49	242	11 + 5	7–7	6–6

* Estimate, since the body is broken and part missing.

TABLE OF MEASUREMENTS OF MICRURUS NIGROCINCTUS MOSQUITENSIS

No.	Sex	Total length	Tail	Snout to vent
15	♂	494	78	316
471	♀	568	58	510
1442	♀	698	75	623
25166	♂	750*	114	636*
25191	♂	480	73	407

* Estimate.

Micrurus pachecoi subsp. nov.

Plate XXII, text fig. 6

Type.—Univ. Kansas Mus. Nat. Hist. No. 25188; Guanacaste, Costa Rica; collector and date unknown.

Diagnosis.—A large species with 22 bands on body and 5 on tail, 6 counting a black tip. Ventrals 215½; subcaudals 40; very few or no black spots on red areas; dark pigment dispersed, slightly

* One of the numbers listed as a paratype, U. S. N. M. No. 9784, is a specimen of *Erythrolamprus aesculapii*; it is possible No. 9785 is intended since this is a coral snake with 19 bands on body and six on the tail. I do not believe this to be a *mosquitensis*, however; the diagnosis of the form mentions body bands "10-19 on the body," and this may be the source of the "19" since all specimens that I regard as authentic *mosquitensis* have a much lower count of black bands.

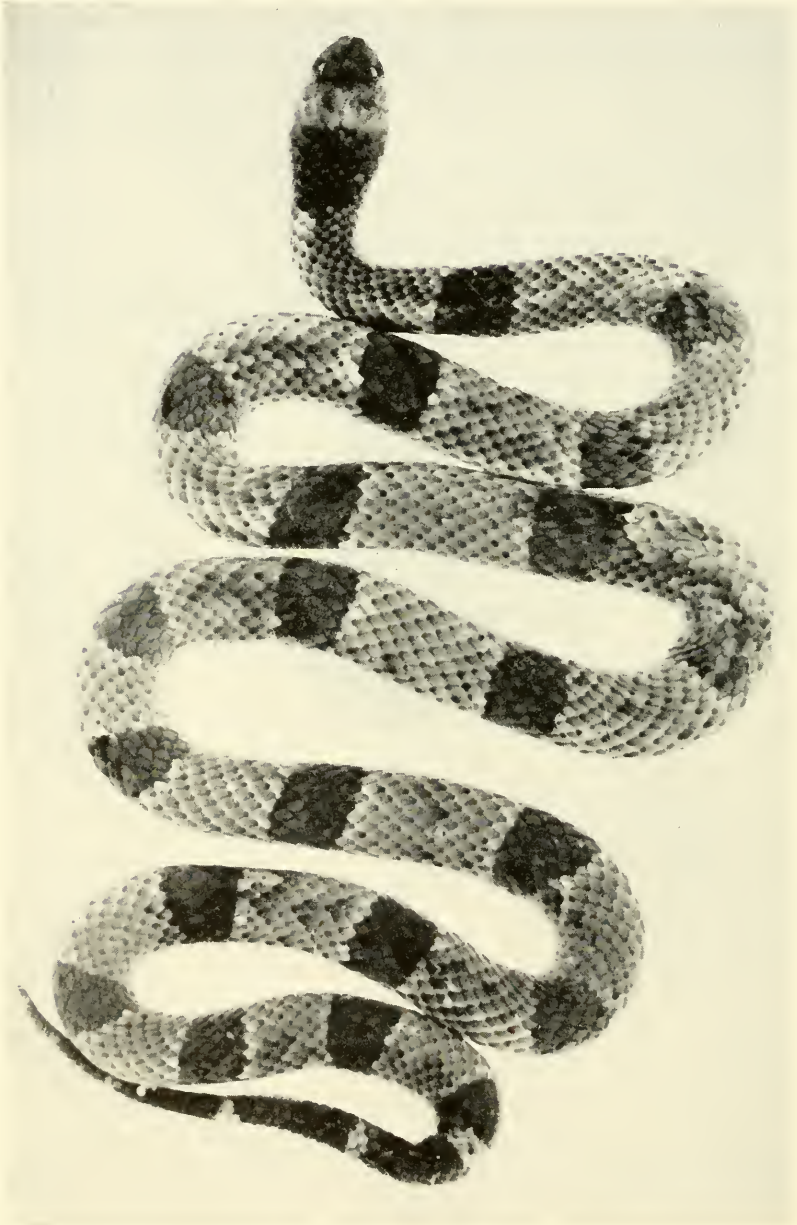


PLATE XXII. *Micrurus pachecoi sp. nov.*, MNH No. 25188, Guanacaste, Costa Rica, August 1947; total length, 984 mm.

heavier near posterior tip of scales; yellow bands narrow, pigmented, about one scale-length wide. Temporals 1 + 2. (Since specimen is female it is impossible to say whether the male may have the keeled scales on sides above anus.)

Description of the type.—Rostral injured, slightly visible from above; internasals a little more than half the length of the prefrontals which are about one fifth wider than long, forming an acute angle between loreal and posterior nasal; *supraoculars equal to or only slightly less than width of frontal; latter scale almost twice as long as wide,* about one fourth or one fifth longer than its distance from tip of snout; length of parietals equal or slightly greater than their distance from snout tip; nasal divided, loreal longer than wide,

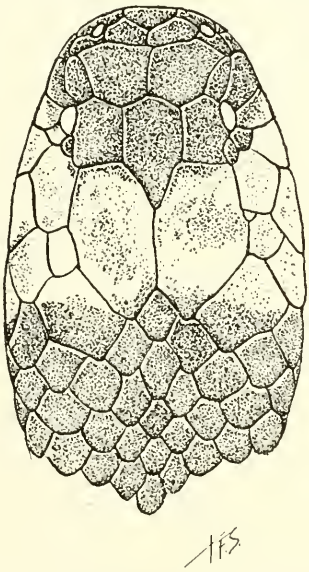


FIG. 6. *Micrurus pachecoi sp. nov.* Type. MNH No. 25188, Guanacaste, Costa Rica.

entering orbit and forming a rather large suture with the supraocular; no preocular; two postoculars; temporals 1 + 2 + 2, upper posterior largest; seven upper labials in the following ascending order of size: 1, 2, 4, 3, 5, 7, 6, third and fourth entering orbit; infralabials seven, four bordering the first chinshields, which are about one fifth shorter than second pair; scales smooth, 15-15-15; ventrals 215½; subcaudals 40; 22 bands on body, 5 on tail, also a black tip.

Measurements in mm.—Total body length, 984; tail 102; snout to vent 882.

Color.—The black bands vary in width between four and five scale-lengths, while on the ventral surface they occupy two or three ventrals. The caudal bands are wider and may cover five to seven subcaudals; the width of the intervening red blotches is from six to eight scale-lengths, occupying six to eight ventrals on the under surface. The usual yellow borders on the black bands are obsolete or nearly so, save that the outer scale may be cream or yellow, very rarely the ventral scale preceding or following the black bands may be partially white. Some of the red scales have black dots but these are not very conspicuous since the whole scale has a brownish wash. The ventrals have a few black flecks on the posterior part of the body. The red bands on the tail are very narrow, one or two scale-lengths in width dorsally; on the subcaudal region the band is as wide as three subcaudals and a black spot is present in the center. Head and snout black, including frontal supraoculars, postoculars, first, second and the upper part of the third and fourth labials. The four anterior infralabials are dull black but the broad yellowish head band is continuous across chin. Dorsally the band is clouded with smoky black, lighter on the supralabials.

Remarks.—The specimen was presented to me alive by Prof. Marco Tullio Pacheco, and it is for him that the species is named.

The peninsula which juts out from the northern part of the west coast of Costa Rica includes much of the province of Guanacaste. It is connected with the main land mass by relatively low land, suggesting that it was formerly an island. I suspect that this species of coral snake was developed when island conditions obtained in the region. The reduction of discrete black spots on the red scales, the larger size of the supraocular scales with reference to the frontal, the increased number of black bands on body and tail, and the temporal formula 1+2, suggest the wisdom of regarding the form as having full specific rank rather than as a subspecies of the related *M. nigrocinctus*, until such time as intergradation is demonstrated. It may, however, be related to that species through *nigrocinctus coibensis* whose range is Coiba Island off the Pacific coast of Panamá.

Micrurus clarki Schmidt

Micrurus clarki Schmidt, Zool, Series Field Mus. Nat. Hist., vol. 20, Oct. 31, 1936, pp. 211-212 (type locality, Yavisa, Darien, Panamá).

This coral snake lacks the supra-anal tubercles in the male. It may be recognized by the following description: body form and general appearance that of *Micrurus corallinus;* supralabials 7-7;

infralabials 7-7; preoculars 1-1; postoculars 2-2; temporals 1 + 1, 1 + 1; ventrals 199, subcaudals 58; parietals angulate at sutures of temporals and post-temporals, and produced at the posterolateral angles into distinct points; 13 black rings on body, usually the width of three ventrals, and seven on tail; the nuchal black ring has a length of six scales, narrowed on belly to three ventrals; yellow, bordering black, one scale-length wide; scales of yellow and red zones uniformly spotted with black at tips; black of head extending to tips of parietals; yellow nuchal scales heavily black-margined; black caudal rings separated by yellow rings which are immaculate beneath but heavily black-mottled above; red ventrals immaculate. (From type description).

I have examined a Costa Rican specimen listed as a paratype. This has 189 (192) ventrals and 53 subcaudals. The black rings are 16 + 8 (9) on body and tail. This specimen, collected by Sr. José Zeledón, is without specific locality data.

Micrurus alleni richardi subsp. nov.

Plate XXIII, text fig. 7

Type.—Univ. Kansas Mus. Nat. Hist. No. 25189, collected by Edward H. Taylor and Richard C. Taylor, Sept. 8, 1947, at Los Diamantes about 2 km. southeast of Guápiles, Costa Rica.

Diagnosis.—A slender elongate form brilliantly colored with yellow-edged black bands on a red body. Black bands, 18 on body, four on tail; ventrals, 241; subcaudals, 32; space between black bands 2½ to 2¾ the length of a black band; scales of red areas with a black spot on each scale; narrow yellow areas with lighter spotting; ventral parts of the red and yellow bands immaculate. Black of snout extending back onto partietals.

Description of the species:—Rostral slightly visible above; internasals about half the length of prefrontals; latter scales very slightly wider than long laterally forming an angle between nasal and loreal; frontal narrow, one and two-thirds as long as wide, sharply angled posteriorly, considerably (¼) longer than its distance from tip of snout; parietals narrow, elongate, about one-sixth longer than frontal, about equal to their distance from internasals; nasal divided; loreal large, forming anterior border of eye and a broad suture with the supraocular; latter scale nearly as broad anteriorly as posteriorly; eye small, about 3.2 times in its distance from snout tip and about once and a half in its distance from the lip; no preocular; two postoculars, upper not noticeably larger than lower; temporals 1 + 1;

a large scale borders the posterior part of parietal; supralabials 7-7, in the following ascending order of size: 1, 2, 4, 3, 5, 7, 6; infralabials 7-7, four bordering anterior chinshields; posterior chinshields narrower and about one-fourth longer than anterior. Scales

PLATE XXIII. *Micrurus alleni richardi subsp. nov.*, MNH No. 25189, Los Diamantes, 2 km. SE Guápiles, Costa Rica, September 8, 1947; total length, 888 mm.

smooth except on side just anterior and posterior to vent, which are keeled. Scale formula, 15-15-15; ventrals, 241; subcaudals, 32; anal divided.

Measurements in mm.—Total length, 888; snout to vent, 815; tail, 73.

Color.—There are 18 black bands on body, and one crossing anterior part of head but incomplete below; four black bands on tail. Body black bands usually as wide as five or six scale-lengths, their anterior borders usually straight, the posterior borders dentate; black bands bordered by one or two rows of yellowish or yellowish white scales with usually a dark spot; intervening bands broad,

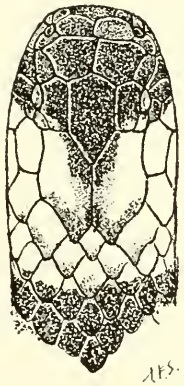


FIG. 7. *Micrurus alleni richardi subsp. nov.* Type. MNH No. 25189, Los Diamantes, Costa Rica.

red, each scale of which bears a black spot; these bands are more than double the width of the black bands, being equal to 10-12 scale-lengths; on ventral surface the black covers three or four ventrals on body, five to six subcaudals; the red and white (yellow) together cover nine or ten ventrals except the first two, which are 15 and 12 respectively; under tail the red occupies four or five pairs of subcaudals; snout and anterior part of infralabials black. This includes first three supralabials, most of the supraoculars, all of the frontal, and some of anterior mesial part of the parietal; posterior edge of the black is bordered by a clouded fawn border that extends to back edge of parietals. Thus the yellow head band is partially interrupted on the median dorsal line but is continuous on sides of head and chin.

Remarks.—The colors of this specimen were extremely brilliant in life. This specimen was apprehended after it had entered a crev-

ice in a stony bank of a small river, and only a small part of the body was in evidence. In the same area within a few hundred yards, specimens of typical *Micrurus nigrocinctus mosquitensis* Schmidt were found.

The fact that this form occurs together with *Micrurus nigrocinctus mosquitensis* leads me to believe that both forms cannot belong to *nigrocinctus*. The elongation of the body, and the great increase in the ventral-subcaudal count causes me to consider *alleni* as a distinct species, although it was described as a subspecies of *nigrocinctus* originally.

The differences between this presumed subspecies and *a. alleni* consists in narrower yellow borders on the black bands, the black spotting on the yellow bands, more elongate red areas, and the immaculate condition of the yellow and red areas on the venter. (Compare the figure given herewith of *alleni richardi* with the figure of *alleni alleni* (*nigrocinctus alleni* Schmidt) given by Schmidt (Zool. Series Field Mus. Nat. Hist., vol. 20, 1936, p. 210).

The species is named for Richard C. Taylor who assisted in the capture of the type.

FAMILY VIPERIDAE

Three genera, *Lachesis, Bothrops* (composite) and *Crotalus,* are recognized as occurring in Costa Rica.

KEY TO COSTA RICAN GENERA OF VIPERIDAE

1. A series of rattles at termination of tail ..... *Crotalus*
   No series of rattles at tip of tail 2
2. Subcaudals partly double, partly quadruple ..... *Lachesis*
   Subcaudals never quadruple, but occasionally partly or wholly double or completely single (composite) ..... *Bothrops*

Genus BOTHROPS Wagler

Bothrops Wagler, *in* Spix, Serpentum Barsiliensium . . . , 1824, p. 50.

Genotype: *Coluber lanceolatus* Lacépède.

The genus as here used is a complex of several genera or subgenera, most, if not all, of which have already been named. Insufficient comparative material prevents me from attempting to resegregate the species into their proper genera.

There are ten species known in Costa Rica.

KEY TO THE SPECIES OF BOTHROPS IN COSTA RICA

1. Supralabials seven, much enlarged; subcaudals divided; large terrestrial snakes reaching two meters in length ..... *atrox atrox*
   Supralabials nine or more; subcaudals all or part (*picadoi* and *nummifer*), single .. 2
2. Two or three more or less erect pointed scales between supraocular scale and eye; tail prehensile, arboreal ..... *schlegelii*
   No erect spinelike scales between supraocular scale and eye 3

3. Second labial forms part of border of loreal pit; green with a cream line on first scale row (young with a blotched pattern)..... *lateralis*
Second labial not forming part of border of loreal pit; no cream line on first scale row 4
4. Rostral scale at least one and a half to one and two-fifths times as high as wide, rising considerably above level of head to form a proboscislike appendage, directed upward; one canthal between internasal and preocular..... 5
Rostral scale reaching no higher than level of head, or at most to height of canthal ridge 6
5. Ventrals 130-145; color pattern of more or less distinct blotches..... *nasuta*
Ventrals 147-159; pattern of more or less regular small black marks..... *lansbergii*
6. Combined supraocular width one fourth (or less) width of head between eyes; large snakes with body scales strongly keeled (and beaded in adults)..... 7
Combined supraocular width usually equal to one half width of head (very rarely one third); scales keeled; but never strongly beaded..... 8
7. Body very thick, short (700-800 mm.); rostral separated or at least partially separated from nasal by a row of intercalated scales..... *nummifer nummifer*
Body longer, thicker (1000 mm. or more); rostral not even partially separated from nasal by intercalated scales..... *picadoi*
8. Color dark green, most scales with black markings; tail prehensile..... *nigroviridis*
Color not green; most scales lacking black markings; tail not prehensile..... 9
9. Dorsal scales on head more or less irregularly enlarged, smooth; black line from eye ..... *godmani*
Dorsal scales on middle of head nearly uniform, those on snout somewhat larger, all keeled; a raised canthal ridge; no distinct black line behind eye; pattern of quadrangular blotches ..... *ophryomegas*

Bothrops schlegelii (Berthold)

Trigonocephalus schlegelii Berthold, Abh. Ges. Wiss. Göttingen, vol. 3, 1846, p. 13, pl. 1, figs. 5-6 (type locality, Colombia).

B[othrops] schlegelii Jan, Elenco systematico degli ofidi, 1863, p. 127.

Bothrops (Teleuraspis) nigroadspersus Steindachner, Sitz. Akad. Wien, Bd. 42, Abt. 1, 1870, p. 348, pl. 8.

Bothrops schlegeli Picado, Serpientes Venenosas de Costa Rica . . . , 1931, pp. 76-80, figs. 32-35 (Santa Clara, Sarapiquí, Miravalles, Volcán Poás).

Two of the so-called color phases of this species were acquired at Turrialba, Costa Rica. The specimen (M.N.H. No. 25162 ♂) is grayish to brownish black with a series of reddish-brown lighter spots, about 22 on body and 6 or 8 on the tail (indistinct posteriorly on tail). The neck is whitish becoming gradually yellowish on anterior half and reddish brown on the posterior part, strongly defined under tail. On the sides of the ventrals and usually including one lateral scale is an irregular series of white spots, often more or less quadrangular; on the anterior part of the body these can be seen outlined faintly by pigment on the medial part of ventrals.

The following scale characters are present: Scale formula 30-21-21-17, the outer row lacking keels; ventrals 160, subcaudals 53; dorsal head scales keeled very strongly, as well as those on temporal region; canthal scales elevated forming low spines. Supralabials 8-8, second almost entirely fused with scale forming anterior border of pit; three small loreals; fourth labial separated from

elongate subocular by two scale rows; infralabials 10-11, first two touching first chinshields, others separated by very small scales; second pair of chinshields separated from each other by a small pair of scales; two elongate, more or less erect pointed scales emerge between supraocular and eye, bordered at their base by a few minute scales; scales bordering canthus, especially two anterior, sharp-edged and partly erect; supraoculars large, longer than wide; posterior part of nasal free, somewhat erect; three preoculars; nasal very large, at most only partially divided.

M.N.H. no. 25159. Aside from being a brilliant yellow (faded with small black spots in evidence, in the preservative) the scale formula is 33-23-25-19-15, which compares poorly with that of the male specimen (30-21-21-19-17). The ventral-subcaudal counts do not differ greatly, the ventrals (♀) being 154½, the subcaudals 54; 160-53 in the male specimen, with totals of 208½ for the female and 213 for the male. Probably in the majority of snake genera, when the scale rows on body normally remain the same in both sexes, the female has a longer snout-to-vent measurement proportionally and the number of ventrals is greater, the subcaudals fewer than in corresponding males of a given population. Where a difference normally exists in the scale rows about body, between the sexes, and the larger number occurs in the females, the number of ventrals may be expected to be equal to those in males, and likewise the totals of the ventrals and subcaudals should be nearly equal. It would appear that the added scale rows represent a compensation so that adequate space is provided for the young in the female, rather than by the more usual procedure of lengthening the body cavity by moving the anal opening a distance of several ventrals to the rear.

For a very long time Schlegel's *B. nigroadaspersus* has been considered a synonym of *B. schlegelii*. If two forms are not involved it may be that the major differences indicated by the two forms are sexual, since the dark specimen taken at Turrialba is a male, the brilliant yellow one a female.

It is not so easy to account for an increase in head size. Presumably larger head size would allow engulfing larger prey and it is not difficult to see the survival value of this, in allowing a wider choice of food with the same effort. However, I strongly suspect that in this case something more than a sex difference is involved.

The measurements of the two specimens are placed here for direct comparison.

MEASUREMENTS OF BOTHROPS SCHLEGELII

No.	Sex	Total length	Snout to vent	Tail	Head length	Head width
25159	♀	448	366	82	27	21
25162	♂	445	365	80	21	17

It is to be noted that a somewhat wider gape, made possible by the larger size, would allow a somewhat larger labial surface and hence the added infralabials. The greater roughness of the head scales of males may represent a secondary sex character such as keeling of scales on sides of anus, rugosities on chins, etc., that are encountered in males of other genera. The more elongate tail is a factor in its prehensility.

In Costa Rica the name Oropel is applied to the yellow form, while the names Bocaraeá or Toboba are applied to the darker-colored forms.

Bothrops lateralis (Peters)

Bothriechis lateralis Peters, Monatsb. Akad. Wiss. Berlin, 1852, p. 674 (type locality, Costa Rica).

Bothrops lateralis Picado, Serpientes venenosas de Costa Rica . . . . 1931, pp. 85-87, figs. 38, 39 (Alturas de Orosi; Santa María de Dota; Montañas de Navarro).

Five specimens of this well-known, easily-recognized species are at hand. The two young specimens (M. N. H. Nos. 25160, 25161) were collected at an elevation between 5000-6000 feet on Volcán Poás at Isla Bonita, and two adults (M. N. H. Nos. 25687, 25688) were collected from the same locality; M. N. H. No. 25163 was taken 2 miles above Santa Cruz on Volcán Turrialba at an elevation of between 6500-7000 feet.

The following characters are evident in the adults: rostral nearly triangular, a little broader than high; nasal single with a slight suture evident; second labial enters pit and forms anterior boundary; loreals, three (rarely four), the upper largest between nasal and upper preocular; supralabials separated from subocular by one scale row.

The scale formula for both sexes is (33-30) 21-21-17; supralabials 10 (rarely 9 or 11); infralabials 12 (more infrequently 11, or 10), three of these touching the anterior chinshields; four pairs of chinshields, all save first pair separated by small scales; usually 3 (rarely 4) postoculars; subocular enlarged.

Body scales rather pointed behind, keeled save on outer row. No. 25163 is uniform green above with a few small yellow flecks; greenish yellow on ventral surface, median area more yellow than outer parts; a whitish line beginning on neck borders the outer ventral

edge and lower edge of first scale row; labials yellowish, chin largely cream; tail bluish green to blue.

Nos. 25687 and 25688 agree closely with the preceding save that the dorsal yellow or light flecks tend to form a transverse series of spots on each side at rather regular intervals, their edges occasionally black, and tending to alternate on the two sides; approximately 22-24 on body, 8 on tail. Young specimens (25160-61) are light lavender (in preservative) with a series of black bars, lighter-edged behind; these may be continuous across back or alternate (there are 23 on body, 6+ on tail); between the bars there are other indefinite black markings. These color differences are those of age only.

The species is known in Costa Rica under the name Culebra Lora. It has been reported from numerous localities.

I have examined specimen A. M. N. H. No. 17372 and specimen U. S. N. M. No. 37730, both from "Costa Rica."

TABLE OF DATA ON BOTHROPS LATERALIS (Peters)

No.	Sex	Ventrals	Subcaudals	Total length	Tail length
25688	♂	166	66	632	105
25687	♀	155	58	760	110
25160	♀	164	61	255	44
25161	♀	169	61	234	43
25163	♀	161	54	715	109

Bothrops nigroviridis nigroviridis (Peters)

Bothriechis nigroviridis Peters, Monatsb. Akad. Wiss. Berlin, 1859, p. 278, pl. —, fig. 4.

Bothrops nigriviridis F. Müller, Verh. Nat. Ges. Basel, Bd. 6, 1878, p. 401; Picado, Serpientes Venenosas de Costa Rica . . . , 1931, pp. 80-85, figs. 36-37 (Volcán de Barba; vertientes del Río Sarapiquí; faldas de Poás, altos de La Palma).

Lachesis nigroviridis Boulenger, Catalogue of the Snakes in the British Museum, vol. 3, 1896, p. 568.

A single specimen (M. N. H. No. 25699 of this species was obtained at Isla Bonita at about 5500 ft. elevation. This form has a rather short head, more or less rounded, the rostral very slightly broader than high; nasals large, single, but sometimes partially divided; five or six loreals; three preoculars, upper large, separated from nasal by upper enlarged loreal; scales on snout imbricate, more or less symmetrical, smooth, about four or five rows between the enlarged supraoculars; latter scales large, the outer edges slightly elevated; one scale below supraoculars bordering eye; one or two postoculars; a large subocular in contact with or separated by one scale from lower preocular; supralabials 9-9, the second separated from pit by a large scale, the third separated from it by a small scale; infralabials 9-9, the first three touch the first pair of chinshields which are larger than two succeeding pairs; all

pairs of chinshields without intercalated scales; scale formula, 25-21-19-19-17, all keeled except outer row; ventrals, 143; subcaudals (single) 50; anal single.

The specimen here described is somewhat discolored by preservative. In life, however, the species is green, strongly speckled with black; a black streak on head from canthus to angle of mouth passing above the eye; top of head may be streaked with black; yellowish beneath, some or all of the shields black edged.

The shed epidermis of this snake is strongly pigmented but in each scale there is a small unpigmented area. Dr. Picado (*loc. cit.*), gives excellent photographs of several living specimens, and notes that it occurs at elevations of more than 2000 m. The Costa Rican name is Víbora de Arbol.

The following specimens have been examined also: A. M. N. H. No. 17283, Volcán Barba; U. S. N. M. Nos. 32580-32581, Pico Blanco.

Bothrops nasuta Bocourt

Bothrops nasutus Bocourt, Ann. Sci. Nat., ser. 5, vol. 10, 1868, p. 202 (Pansas, bank of Polochic, Guatemala); Amaral, Bull. Antiv. Inst. Amer., vol. 3, 1929, pp. 25-27, pl. 3, a-d, text fig. 7 (Zent, Limón and Sipurio, C. R.); ? Picado, (*part.*) Serpientes Venenosas de Costa Rica . . . , 1931, pp. 69-73, figs. 30, 31.

Snout pointed, turned up at end with a sharp canthus rostralis; rostral usually 1½ times as high as wide; canthus formed from one elongate internasal, one canthal and upper part of preocular, their edges rough. Nasal not completely divided; a pair of elongate internasals, elevated anteriorly; upper head scales imbricate, strongly keeled; large supraoculars separated by from five to seven scale series; two or three scale rows between labials and eye; subocular sometimes broken; temporals all keeled; supralabials nine to eleven, none bordering the sensory pit; scales of body 23-27 (23-25); ventrals 130-145; anal entire; subcaudals single, 24-35; body slender, tail short, not prehensile.

Yellowish brown, pale brown or grayish above, with a dorsal series of 13-20 large, dark brown, black-edged rhomboidal or squarish spots, usually divided on median line by a narrow white or orange line; occasionally the spots on the two sides tend to alternate; sides of head blackish; belly powdered with brown with or without whitish spots.

The species is known to occur on the Carribean drainage area. In Costa Rica it is known under the name Toboba Chinga.

I have examined the following specimens: A. M. N. H. Nos.

17287, 17308, Sarapiquí; No. 17332, Sipurio; U. M. M. Z. No. 17306, San José.

It has also been reported from Zent and Limón on the east coast.

Bothrops ophryomegas Bocourt

Bothrops ophryomegas Bocourt, Ann. Sci. Nat., ser. 5, vol. 10, 1868, p. 201 (type locality, Occidental slope of Esciuntla range, Guatemala); Amaral, Bull. Antiv. Inst. Amer., vol. 3, no. 1, 1929, pp. 23-24.

Data for this is taken from Amaral's redescription (*loc. cit.*). Body long and slender, tail short, not prehensile; head wide, snout not turned up; canthus rostralis raised and sharp, formed by one internasal, two canthals and upper part of preocular; rostral slightly higher than wide; internasals short and straight; canthals double and small; supraoculars large with ridgelike border; head scales keeled; supralabials 9-10; body scales in 25-27 rows; ventrals 166-173; subcaudals entire, 32-39.

Brown above with 26 to 40 small black markings placed in pairs along the vertebral line alternating with or opposite to those of other side; flanks with darks spots in pairs; corresponding to vertebral markings; belly light, speckled or transversely marked with brown; sides blotched with dark; head with a dark line behind eye and dark markings on the top; lips with light spots.

I have examined specimens of this species as follows: U. M. M. Z. No. 83183 Esparta; No. 83184 Puntarenas; U. S. N. M. No. 37728 Esparta and No. 37729 Jiménez.

This form is regarded by Amaral as belonging to the arid, west coast areas of Central America.

Bothrops lansbergii (Schlegel)

Trigonocephalus lansbergii Schlegel, Mag. de Zool., 1841, 1-3, Rept. pl. 1 (type locality, Turbaco, Colombia).

Bothrops lansbergii Jan, Elenco sistematico degli ofidi, 1863, p. 127 (Costa Rica, etc.); Amaral, Bull. Antiv. Inst. Amer., vol. 1, no. 1, 1927, p. 22, and *ibid*, vol. 3, no. 1, pp. 19-27, fig 1; Dunn, *ibid*, vol. 2, no. 2, 1928, pp. 29-30; Loveridge, *ibid*, vol. 2, no. 3, pp. 64-65.

This species is represented in my material by a single female specimen (M. N. H. No. 25689) obtained at Turrialba, July 11, 1947. The characters of this specimen are: body rather thick and short; tail short; rostral vertical, the width in height one and one half times; three ridged canthals, the anterior elongate, bordering its fellow on median line behind rostral; a small median scale follows their common suture; third scale on canthus is the very large upper preocular; supraoculars border orbit, one and a third times as long as wide; six scales between the supraoculars; head scales

dimly keeled, except perhaps the first row on snout; nasal large, with a small entrant suture from top, the posterior part of scale concave; seven small and two large loreal scales; second preocular bordering upper part of pit broken into three scales; lower preocular small; two rows of small scales between anterior labials and pit; four rows of scales between labials and eye (or 3 rows and subocular, latter may be broken); supralabials 10-9, fourth distinctly largest; infralabials 11-10, three touching first pair of chinshields which are more than twice as long and at least three times area of second pair; anterior chin scales, labials, nasal and rostral more or less covered with small tubercles; scale formula; 39-25-23-23-19; ventrals, 139; subcaudals, 28, single; anal single.

Dorsal color bluish to ash gray with small discrete black spots, the ventral coloration being lavender; a few white flecks present low on sides, extending occasionally onto ventrals; dark spots arranged in groups of four as if marking the four corners of a quadrangle, and opposite or (occasionally) alternate with a similar grouping on opposite side; 15 present on each side. On underside of jaw some light lavender marks, the one beginning back of jaw angle forming an irregular line for a short distance.

The name by which this species is known in Costa Rica is La Tamagá; it is said to reach half a meter in length only rarely. This specimen has a total length of 294 mm.; tail, 31 mm.

Males and females differ somewhat in the character of the canthus. In females this rough, serrated appearance is lacking almost completely. The known ventral range is 130-145; subcaudal range, 24-35, according to Amaral.

Bothrops atrox atrox (Linnaeus)

Coluber atrox Linnaeus, Museum Adolphus Friderici regis, vol. 1, 1754, p. 33, pl. 22, fig. 2, and Systema Naturae, vol. 1, 1766, p. 383 (type locality ?).

Bothrops atrox (*part.*) Duméril, Bibron and Duméril, Erpétologie Générale, vol. 7, 1854, pp. 1507-1509.

This great pit viper, known commonly under the name *La Terciopelo,* is, according to Sr. C. Picado-T., the most feared snake in the country of Costa Rica, because of its deadly bite and great size. It is reported as reaching a length a little greater than two meters.

A specimen, M. N. H. No. 25677, was killed close to the central station at Los Diamantes (rubber plantation) near Guápiles in early September 1947, and presented to us by Mr. Wallace Manis, the Director of the plantation and our genial host.

Scale data on this specimen follow: rostral as wide as high, visible above as a tiny triangle bent flat on tip of snout; two canthal

scales form a bordering keel together with upper edge of the upper preocular; supraoculars very large, twice as long as wide, separated from each other by six or seven scale rows; upper surface of snout a little more elevated than interocular area; nasal completely divided; two loreals, upper largest; second labial forming anterior border of pit, the scale showing a partial division; supralabials 7-7, all very large save first two; subocular irregular, elongate, lower preocular divided vertically; two scales between subocular and second labial; one scale row between fourth labial and subocular; dorsal head scales keeled; lateral scales of head smooth save the upper temporals; ten lower labials, three touching first chinshields, which are a little longer and considerably larger than second pair; scales strongly keeled; the scale formula, 33-27-27-19; anal single; ventrals 192; subcaudals divided, 67; total length, 1773 mm.; the tail, 223 mm.

It has been reported from numerous localities in the lowlands.

Bothrops picadoi (Dunn)

Trimeresurus nummifer picadoi Dunn, Proc. Biol. Soc. Washington, vol 52. 1939, pp. 165-168, (La Palma, C. R., elev. 4500 ft.).
Bothrops picadoi Smith and Taylor, Bull. U. S. Nat. Mus., No. 187, Oct. 5, 1945, pp. 182-183.

This large species, which in size stands between *nummifer* and *atrox*, seems to occupy a region on the central plateau of Costa Rica and the surrounding mountains. The specimens in the collection M. N. H. (Nos. 25672-75) were obtained at Isla Bonita (A. C. P.) on the eastern slope of Volcán Poás at an elevation between 5000 and 6000 ft. In this area it is confused with the *mano de piedra* (*nummifer*), under which name it is known.

Rostral more than once and a half as wide as high, reaching level of snout, visible above as a rather narrow line; nasals completely divided, the anterior larger part bordering rostral without any intercalated scales; supraocular broken up and a small narrow elongate part of it, differentiated from other head scales, borders eye and is separated from its fellow by eleven rows of lightly keeled head scales; canthal scales not forming a shelf; a large loreal between very large preocular and posterior nasal; one to three small loreals below this scale; subocular elongate, narrow; three postoculars; a large triangular upper preocular, and small lower which borders pit; supralabials 9-10, the first, second and third separated from scales surrounding pit by one scale row, fourth and fifth separated from labials by three or four scales; infralabials 9-11, two touch first pair of chinshields which are more than twice length of second

or third pairs, and three times area of second pair; the first pair of infralabials are separated in four out of six cases, and in these exceptions they are very narrowly in contact. All scales are keeled or beaded, the keel widening and forming a low rounded mound posteriorly on the scale. This is especially prominent on the females, less so in males.

The type of this species which I have examined is a young specimen with the markings differing slightly from specimens here recorded. One other specimen, R. C. T. No. 695, is included on the data sheet.

TABLE OF DATA FOR BOTHROPS PICADOI (Dunn)

No.	Sex	Scale formula	Ventrals	Subcaudals	Supralabials	Infralabials
695	♂	28–25–21	146	38	9–10	11–11
25675	♀	30–25–21	148	32	10–10	11–11
25676	♀	30–25–21	152	23+	10–10	11–11
25673	♀	33–25–21	146	33	10–10	11–12
25672	♀	33–25–21	149	33	9– 9	11–11
25674	♂	31–25–21	146	40	9– 9	10–10

TABLE OF DATA FOR BOTHROPS PICADOI (Dunn) (concluded)

No.	First infralabials separated	Infralabials touch chinshields	Total length	Tail	Divided subcaudals
695	no	2	1202	120	11 (5, 14–24)
25675	yes	2	955	89	0
25676	yes	3	930+	68+	0
25673	yes	2	257	27	0
25672	no	2	269	30	13 (12-25)
25674	yes	2	249	29	2 (last two)

Bothrops nummifer nummifer (Rüppell)

Atropos nummifer Rüppell, Verz. Mus. Senck., Amph., 1845, p. 21 (type locality, Mexico).
Bothrops nummifer Jan, Elenco Systematico degli Ofidi, 1863, p. 126.

This extremely thick, short snake is known in Costa Rica under the name *mano de piedra.* It ordinarily reaches but little more than half a meter in length, but the body is as thick as that of *picadoi* of nearly double its length. The most distinctive characteristic of the snake is the strong ridge on the back, especially prominent on the anterior half of the body, bearing three scale rows, a median and two adjoining lateral rows all very heavily keeled or tubercled. One specimen, M. N. H. No. 25678, was obtained at the Inter-American Institute of Agriculture, three km. west of Turrialba.

In this the following scale characters obtain: rostral triangular, not visible above, distinctly wider than high, separated from nasal on right side by three intercalated scales, on left by two scales only, thus allowing rostral and nasal to touch at one point; nasal divided

completely, the anterior part the larger and somewhat convex; dorsal head scales heavily keeled, the anterior ones tending to bend down to touch rostral in front, and in canthal and supraorbital regions, to form slightly projecting shelves; an elongate loreal borders canthal edge touching first supraocular and posterior nasal; eight or nine small loreals; supraocular broken into several small scales, not or scarcely larger than adjoining scales; subocular narrow, elongate; two or three postoculars; only one large preocular; the two scales below it are pushed forward more than their length in front of the eye; supralabials 9-10; third separated from facial pit by two or three scale rows, fourth and fifth separated from subocular by three rows; infralabials 12-13, three touch first chinshields which are double size of two succeeding pairs.

Scales keeled, the scale formula being 30-25-19; ventrals 122; subcaudals 35, first two pairs divided, others single. The total length is 790 mm.; tail, 91 mm.; head width, 45 mm.; head length, 57 mm.; height of body, 55 mm.

The basal pattern gray with 16 saddlelike darker brown rhombs on back, each with a somewhat lighter center and each with a narrow lateral extension onto the ventrals; low on sides a series of small black spots alternating with the rhombs; frequently rhombs are contiguous middorsally and bordered by lighter gray color, especially along the upper parts; base of tail with two discernible rhombs but the remainder of tail black above and below; a diagonal black stripe from eye to behind jaw angle; chin, throat and anterior part of body white on ventral surface; but posterior part of body clouded with pigment and numerous more or less quadrangular black spots.

The specimen when in captivity was quiet, save that on being disturbed by the approach of anyone, the head was moved in a series of slight rapid jerks. When dissected it was found to contain 27 embryos.

This is a wide-ranging species occurring as far north as San Luis Potosí, Mexico. Known variation in ventrals, 121-135; subcaudals 26-37, the higher numbers being from the northern part of the range.

The species has been reported in the literature from El General, Monte Redondo, Chitaria, Cariblanco, Peralta, Guápiles, and Siquirres, in Costa Rica.

Bothrops godmani (Günther)

Bothriechis godmanni Günther, Ann. Mag. Nat. Hist., vol. 12, 1863, p. 364, pl. 6, fig. G, G' (near Dueñas, and on other parts of the tableland of Guatemala). (The species was named for Godman. The original "*Godmanni*" constitutes an error of transliteration.)
Bothrops godmanni Amaral, Mem. Inst. Butantan, tome 4, 1929, p. 235 (or 109).

This species, recently collected in Panamá, occurs to the north of Costa Rica and perchance will eventually be found in Costa Rica. I know of no records to date. It may be characterized as follows: rostral broader than high, extending to upper level of head, equally as high as the anterior nasals, but broader than high; supraoculars large, often with other somewhat enlarged scales (frontal or parietals) appearing; number of scales between supraoculars from three to seven; scales of top of head keeled; nasal divided, the anterior part largest and not separated from rostral by intercalated scales; a large preocular separated by the large loreal from the posterior nasal; supralabials 9-9, the second not joined to pit scale, or bordering pit; a single series of scales between labials and elongate narrow subocular; 10-11 infralabials, four touching chinshields; second chinshields small, separated by a pair of scales; scale rows 23-21-21-19(17), keeled except outer row; ventrals 146; anal single; subcaudals 36, none divided.

Above olive gray with a black stripe beginning behind eye and reaching onto neck, bordered above and below by whitish, touching two or three supralabials; side of head, labials, and chin grayish white; body gray-olive with a series of median blotches of brownish black, darker edged, often contiguous or confluent; a series of lateral spots usually bordered with whitish gray. On outer edge of ventrals a series of spots that may be partly edged with whitish, becoming obsolete or merged with dark ventral coloration. Throat grayish white; body becoming rapidly darker until on the latter half body nearly uniform black. (U. S. N. M. No. 24782.)

The measurements are: total length 550 mm.; tail 65 mm.

The known variation in ventrals is from 142 to 148; subcaudals 28 to 36.

Genus CROTALUS Linnaeus

Crotalus Linnaeus, Systema Naturae, 10th ed., vol. 1, 1758, p. 214.

Genotype: *Crotalus horridus* Linnaeus.

A single species is known to occur in Costa Rica.

Crotalus terrificus durissus Linnaeus

Crotalus durissus Linné, Systema Naturae, vol. 1, p. 372, 1766 (type locality unknown).
Crotalus terrificus Picado, Serpientes Venenosas de Costa Rica, 1931, pp. 43-53, figs. 1 and 14-19.

This large rattlesnake formerly had a range well onto the plateau,

specimens having been obtained some distance east of Cartago. It has become rare or has disappeared largely from plateau country according to Dr. Picado.

The species may be readily recognized by the presence of a series of rattles on the tip of the tail. In the very young specimens only a small button is present.

A specimen, U. S. N. M. No. 13534, from San José, Costa Rica, has been examined. The scale formula is 26-25-25-19; ventrals 172, subcaudals 25; the first, and last three subcaudals are divided, others single; 14 infralabials; four rows of scales between labials and eye; internasals and prefrontals present; supraoculars large, separated anteriorly by two scales, posteriorly by five scales; 25 scales across head between last supralabials.

Genus LACHESIS Daudin

Lachesis Daudin, Histoire Naturelle des Reptiles, vol. 5, 1803, p. 349.

Genotype: *Lachesis muta* (Linnaeus.)

A single species is known to occur in Costa Rica.

Lachesis muta stenophrys Cope

Crotalus mutus Linnaeus, Systema Naturae, vol. 1, 1766, p. 373 (? Surinam).

Lachesis stenophrys Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1876 (1875), p. 152 (Sipurio, Costa Rica).

Lachesis muta Picado, Serpientes Venenosas de Costa Rica, San José, Costa Rica, 1931, pp. 37-43, figs. 10-12 (Río Banana).

This large Bushmaster or Cascabela muda seems to be a rare snake in Costa Rica. It reaches a greater size than any other of the poisonous snakes of the country. Picado shows a photograph of a specimen 2150 mm. in length.

This species may be recognized by the following characters: rostral triangular, broader than deep, the muzzle short and depressed; nasal divided; scales on top of head flat, hexagonal and faintly keeled; 12 series of scales between the supraoculars which are of moderate size, but narrow; nine supralabials, of which the third is largest; second low, separated from the pit; pit bordered by three scales, the superior of which borders the two preoculars; the inferior, wider, stands on the third labial and the anterior, which is subcrescentic, and rests on the second supralabial; four rows of scales separate orbit from labials; infralabials 13, first and second touch chinshields; only one pair of chinshields, squarely truncate anteriorly, narrowly rounded behind. Ventrals 200; subcaudals 49 (32 double, 17 quadruple); caudal spine well developed.

Color in preservative, fawn-brown with 23 reddish-brown medium rhombs on the dorsal region. The lateral corners of these are dark spots, sometimes isolated and do not extend below fifth row of scales; on middle of body rhombs with pale centers; posteriorly they are darker and become confluent into a zigzag band. Tail dark brown, with narrow, light cross-bands. Lower surfaces greenish yellow except throat and chin which are white. A black band extends from eye above labials, and is broken upon neck into a series of black spots. Top of head uniform brown.

Boulenger has placed Cope's *L. stenophrys* in the synonymy of *L. mutus*. However the very low ventral count (Boulenger gives 200-230 throughout the range with counts of 202 and 206 for Panamá [200 for type of *stenophrys*] and higher counts 223-226 for contintental South America) suggests that it should be considered a separable form. Also there are some differences in color and pattern.

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A New Veracrucian Salamander

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Recent collections made in Mexico by Mr. Walter W. Dalquest* for the Museum of Natural History of Kansas University contain a series of salamanders belonging to the genus *Bolitoglossa,* from the lowlands of southern Veracruz. The species is regarded as new and is herewith described.

The specimens were collected at night on the lower edge of a great limestone cliff, the exposed section of the outcrop being "nearly one hundred feet in thickness." Individuals occupy the small nooks and crannies in the limestone in the daytime and at night they move about the face of the cliff presumably in search of food. They are not or only slightly disturbed by the light and are captured with comparative ease.

No other species of salamanders, except *Bolitoglossa platydactyla* (Gray), has been taken in the immediate vicinity of the type locality; however, *Bolitoglossa rufescens* probably occurs also. The little-known *Bolitoglossa yucatana* (Peters) may occur in this area, as it occupies terrain in limestone regions of the Yucatán peninsula. The differences from this form are discussed later, since the two forms seemingly belong in the same section of the genus.

Bolitoglossa veracrucis sp. nov.

Type.—U.K.M.N.H. No. 26941; collected at a point 35 km. SE of Jesús Carranza (Santa Lucretia), elev. approx. 350 feet, Veracruz, Mexico, April 6, 1949. Walter W. Dalquest, collector.

* The Museum wishes to acknowledge financial assistance from the University of Kansas Endowment Association for Mr. Dalquest's collecting in Mexico.

Paratypes.—U.K.M.N.H. Nos. 26933-26940; 26942-26953; same date, locality and collector.

Diagnosis. — A medium salamander, maximum known length (snout to end of vent), 55 mm.; in adults, width of head in head-body length 5.5-6.25 times; length of head in head-body length 5 to 5.7 times; costal grooves 13, counting one in axilla and one in groin; tail with a strong basal constriction; tail less than head-body length; hand and foot palmate, spread widely, somewhat emargi-

Bolitoglossa veracrucis sp. nov.

Fig. 1, UKMNH No. 26953 paratype. Fig. 2, No. 26938 paratype. Fig. 3, No. 26941 type. All from 35 km SE of Jesús Carranza (Santa Lucretia), Veracruz. (elev. approx. 350 ft.) (See text for actual size).

nate between digits; vomerine teeth usually in a single continuous or in a somewhat irregular row, 12-19 in number, curving back slightly and nearly meeting mesially; four premaxillary teeth pierce lip in males.

Description of the type.—Head broad, depressed, the snout truncate protruding beyond mouth more than 1 mm.; in dorsal profile the end of snout slightly concave between the subnarial

swellings; seen in lateral profile there is an emargination of the line of upper lip immediately behind subnarial swellings; latter somewhat bulbous, slightly pendant; canthus rostralis not present, the snout rounded, the lores sloping gradually to lip; eye rather large, slightly longer than median length of snout; width of an eyelid contained in interorbital distance approximately $1\frac{1}{3}$ times; no orbitolabial groove; posterior parts of eyelids concealed under a short diagonal fold; line of the mouth forming an angle under posterior part of eye; a postorbital groove faintly indicated; a verticle groove indicated back of jaw angle which may be traced on side of head and on throat; an ample gular fold, very slightly curved across neck, scarcely traceable on the sides of neck; elevation made by the posterior part of the epibranchial cartilage, passes above arm to second costal groove; nostrils small; skin on head porous; musculature of the posterior part of head and beginning of neck causing distinct and regular elevations of the skin dorsally and laterally; skin on lateral costal folds with some longitudinal wrinkling; the upper parts of the costal grooves form zigzag lines reaching to near the median dorsal line; about 25 caudal grooves discernible; tail quadrangular in cross section; an indistinct groove on under surface of tail.

Arm reaching middle of eye; hand palmate, tip of third finger webbed but extending forward as a slight triangle; tips of other fingers scarcely free; foot palmate, the edges with slight emarginations between tips of toes; lateral cloacal walls covered with papilla in male.

Tongue bolitoglossid; no trace of a sublingual fold; four premaxillary teeth penetrating edge of upper lip (one missing in type); vomerine teeth 14-15, in two transverse series, bending back a little and forming an angle mesially, the two series separated mesially by a distance equal to that between two teeth; paravomerine teeth tending to form a single patch narrowed anteriorly, expanded posteriorly with a slight median posterior notch; maxillary teeth small, 30-32; there is a hiatus anteriorly between maxillary and premaxillary series.

Measurements in mm.—Snout to end of vent 50; tail 46; width of head 8.0; length of head to behind jaw angle 10; length of head to gular fold 13.5; arm 12.3; leg 13; axilla to groin 26.5.

Color and markings.—Lavender-brown with irregular series of clay or fawn-colored spots scattered from snout to tail tip, the spots varying in size; spots small low on side; venter and under side of limbs and tail lighter lavender-brown, the individual chromato-

phores separate, with numerous small cream or yellow spots (not longitudinal); a small lighter glandular area behind insertion of thigh; a white line along lower edge of lower eyelid; limbs spotted like body; cloacal walls of males without pigment (female with cloacal walls pigmented).

TABLE OF MEASUREMENTS OF ADULT BOLITOGLOSSA VERACRUCIS

No.	Sex	Snout to end of vent	Tail length	Head width	Head length	Arm	Leg	Axilla to groin	Snout to gular fold
26940	♀	55	..	9	10.3	12.5	14	32	14
26941	♂	50	46	8	10	12.3	13	26.5	13.5
26942	♂	50	42	9	10	12.4	12	28	13
26938	♀	50	42	8.4	9.8	12.5	13.2	28	13
26947	♂	47.5	..	8	9.5	11.5	11.5	25.5	12.2
26939	♀	46	..	7.7	8	11	11	25	11.9

TABLE OF DATA ON BOLITOGLOSSA VERACRUCIS

No.	Sex	Costal grooves	Vomerine teeth	Maxillary teeth	Premaxillary
26940	♀	13–13	17–19	31–29	6
26941	♂	13–13	14–15	30–33	3 (+ 1)
26942	♂	13–13	14–13	35–29	4
26938	♀	13–13	19–17	37–39	6
26947	♂	13–13	12–14	27–26	5 (+ 1)
26939	♀	13–13	17–15	24–26	4

Variation.—The series of specimens range in size from 22-55 mm., snout-to-end-of-vent measurement. They vary considerably in color but this variation does not seem to have any relation to sex or age. Some of the younger specimens are largely fawn on the dorsal surfaces, with a few black flecks. Some of the young are colored much as are the adults. The costal grooves are 13 in all if one counts a groove in axilla and groin; occasionally a partial division is suggested in the last costal fold.

Dentition is lacking in the young but specimens above 45 mm. snout-to-vent length seem to have the adult dentition. The number of teeth in females is a little greater than in the males, there being normally six premaxillaries penetrating the gum in females and four normally in the males penetrating the upper lip. There seemingly is a higher count of vomerine teeth in females than in males as suggested by the table of data. The subnarial swellings are less bulbous and less pendant in females, and the cloacal wall has numerous pigmented folds instead of papilla. It is presumed that the considerable series taken in the same locality and at the same time contains specimens of fully grown animals. That some of the animals attain larger size than those given here is to be expected; I doubt, however, that this difference will be very considerable.

Relationship.—The salamanders here described belong in the genus *Bolitoglossa* and probably in the section of the genus that includes *Bolitoglossa odonelli* (Stuart), *Bolitoglossa mulleri* (Brocchi), and not impossibly also *Bolitoglossa yucatana* (Peters). The two former species are mountain forms that differ from the one here described in having fewer teeth, shorter limbs in proportion to the axilla to groin measurements, a different basal coloration and different dorsal markings. Both are presumably larger species. The total length is 123 mm. for *odonelli;* for *mulleri*, as given by Stuart (1943), 145. The tail length of *odonelli* is practically that of head-body length (61-62 mm. in the type) and varying but little in the paratypes. Stuart has omitted several important characters from his description such as the presence of absence of the sublingual fold, the paravomerine teeth, the maxillary teeth, etc.

From *yucatana* this form differs in being of smaller size, vomerine teeth not an "irregular patch of teeth," no ventral linear markings, markings not concentrated in two dorsolateral lines, long limbs in proportion to axilla-to-groin length (one to one and a half costal folds between adpressed limbs instead of five folds), snout depressed instead of "quite high," the tail shorter than body.

Stuart (1943)* calls attention to my error in using *punctatus* when *mulleri* is intended, a curious error resulting from the dropping of a complete line of text. *Punctatus* definitely does not belong in this group.

* While it is not pertinent I wish to call attention to a confusing error of Stuart, p. 16, where he states that Taylor has described *Bolitoglossa nigrofilavescens* from Chiapas. This name has not been used by Taylor.

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Taxonomic and Geographic Comments on Guatemalan Salamanders of the Genus *Oedipus*. Misc. Publ. Mus. Zool. Univ. Michigan No. 56, 1943, pp. 1-33, pls. 1-2.

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A New Species of *Leiolopisma* (Reptilia: Sauria) from Mexico*

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ABSTRACT. *Leiolopisma caudaequinae* is described from Horsetail Falls, near Monterrey, Nuevo León, Mexico, the type in the Museum of Natural History, University of Illinois. The status of the other four North American members of its group is discussed and *L. forbesorum* and *L. gemmingeri* are regarded as subspecies. A key to the five forms is appended.

A *Leiolopisma* recently received as a gift to the University of Illinois Museum of Natural History from Mr. J. P. Craig, and collected at Horsetail Falls in Nuevo León, Mexico, differs markedly, but chiefly in leg proportions, from its closest geographic relative, *L. forbesorum* of high elevations in the state of Hidalgo. A query to the authority on Mexican *Leiolopisma,* Dr. Edward H. Taylor, revealed that for a number of years he has possessed specimens of the long-legged northern species from San Luis Potosí. Upon his suggestion the form is named herewith. I am indebted to him for the loan of comparative material and assistance in preparing this account, and to J. P. Craig for the gift of the type.

Leiolopisma caudaequinae† sp. nov.

Holotype. Univ. Ill. Mus. Nat. Hist. No. 10131, an adult male from Horsetail Falls, 25 miles south of Monterrey, Nuevo, León, collected by J. P. Craig, April 19, 1946. *Paratypes.*— Two, E. H. Taylor Coll. Nos. 23886, 23892, from a locality 10 miles west of Naranjo, San Luis Potosí, on the Antiguo Morelos-San Luis Potosí highway, along a small creek. *Hypoparatypes.* Four, E. H. Taylor Coll. Nos. 23888-23891 (all juveniles), from the same locality as the paratypes.

* Contribution from the Museum of Natural History and the Department of Zoology, University of Illinois, Urbana, Illinois.

† In reference to Horsetail Falls, the type locality.

Diagnosis.—A member of the genus *Leiolopisma* similar and related to *L. silvicolum*, having a divided frontoparietal, 61-70 dorsals, a brown lateral stripe involving ear, 28-32 scale rows, and large, strong limbs overlapping in adults when adpressed and the forelimb reaching eye; differing from *silvicolum* in having usually 1 pair of nuchals, 17-19 lamellae under the fourth toe, and a continuous, unbroken dorsolateral light stripe.

Description of holotype.—A mature male; frontal elongate, width 4/5 of length, its distance from tip of snout ¾ its length, which is about 5/6 length of frontoparietals and interparietal combined; internasal very large, almost as long as broad, in contact with frontal by a suture almost as long as that with rostral; prefrontals a fourth larger than nasals; frontoparietal divided, the median suture 2/3 length of interparietal; parietals in contact behind frontal with a suture 1/5 length of interparietal. Four supraoculars, anterior narrowly in contact with prefrontal, 2nd narrowly in contact with frontoparietal, 3rd smallest; 7 superciliaries, anterior largest. Nasal entire; postnasal 2/3 size of nasal (divided into 2 superimposed scales on 1 side); a nearly square loreal ¼ larger than anterior superciliary; one large (lower) and 3 (4 on one side) small preoculars; 2 presuboculars above 4th supralabial, a little smaller than large lower preocular; 2 tiny suboculars above 5th supralabial; two postsuboculars in contact with 6th supralabial; 3 large and several small postoculars; nine upper and 12 lower palpebrals. Seven supralabials, 6th slightly larger than 7th, 4th smallest; mental with a longer labial border than rostral; 6 infralabials, 5th longest, 1st smallest; postmental nearly twice as large as mental, in contact laterally with 2 infralabials; 3 chinshields on each side, the scales of the anterior pair in contact medially, those of 2nd separated by 1 scale, the 3rd by 3; a small postgenial, longer than broad.

Ear large, 1.6 x 1.1 mm., tympanum deeply sunken; anterior temporal very slightly larger than lower secondary; upper secondary temporal very large, 2/3 size of parietal; two relatively large postlabials followed by 3 vertical rows of small scales in front of ear; 1 large pair of nuchals, in contact with secondary temporal; on one side a smaller nuchal behind the other; two tertiary temporals, lower largest, between nuchal and postlabials.

Dorsal and lateral scales with several minute keels or pits, especially prominent on lateral scales; 63 scales from interparietal to level of posterior edge of hind leg; 30 scale rows at middle of body; 17 lamellae on 4th toe.

Limbs large, overlapping 3 scale-lengths, forelimb reaching rear corner of eye opening; median subcaudals a little wider than adjacent scales, and a little longer, every other scale in contact laterally with two scales (a large and a small), the alternating scales in contact with one on each side; regenerated portion of tail with broad median subcaudals each in contact laterally with one scale.

Ground color a dark tan; dorsal surface not marked; a fine dorsolateral light line, lacking melanophores, with a well-defined lateral border (formed by a very dark brown lateral band), and a dimly evident median border, following median edge of the 4th scale row, originating on snout and terminating near base of tail; a lateral, very dark brown, continuous band (not interrupted by light streaks) below this, occupying 2 and 2 half scale rows, its lower edge rather irregular and tending to blend gradually with the adjacent slate color; sides below band sparsely pigmented; belly not pigmented; a few melanophores on sides of ventral surfaces of neck and head; a poorly defined light line from snout below eye and through ear to arm insertion.

Variation.—The paratypes are very similar to the type. Variations in important features are indicated in the accompanying table. The four hypoparatypes likewise are very similar, and agree in all diagnostic characters, even limb proportions. Since a differential growth rate occurs in these lizards, the most reliable proportions are, however, those of the adult, to which generalizations here are restricted. The dorsal scales number 62, 64 and 67 in hypoparatypes which can be counted, and the scale rows around middle of body 28, 28, 30, 32 (all carefully checked several times). The nuchals are 1 pair in two, 1-½ pairs in one, 2 pairs in one; the members of the anterior pair are separated from upper secondary temporal in 3, from each other in 1. The lamellae under the 4th toe are 18 (two) and 19 (two).

Comparisons.—From *forbesorum* the present form differs chiefly in length of foreleg (reaching orbit) and extent of overlap of adpressed limbs (touching or overlapping as much as 7 scale lengths). In *forbesorum* the foreleg does not extend forward beyond a point halfway between eye and ear, and the adpressed limbs are separated by from 1 to 8 scales. The most conspicuous difference is in limb proportions, those of *caudaequinae* being conspicuously larger and longer than those of *g. forbesorum*. In addition the new species possesses a different curve of variation in scale row count around middle of body (28, four; 30, two; 32, one), although it overlaps

that of *g. forbesorum* (26, two; 27, one; 28, seven) so greatly that it has no diagnostic value, and even its significance is questionable.

L. gemmingeri, like *forbesorum,* has short limbs. *L. silvicolum,* the only other species in Mexico of this group, has long limbs as in *caudaequinae,* but the nuchals are usually in 2 rows, the lamellae under the 4th toe 20, the dorsolateral light stripe is broken, and the scale rows more regularly 30 or 32.

Relationships.—The "Oligosoma" group of Taylor (Copeia, 1937, p. 11) in North America consists of *laterale, gemmingeri, forbesorum, caudaequinae* and *silvicolum.* It is characterized by having a divided frontoparietal, and a peculiar variation in size of the paraventral subcaudals, so that many scales of the median row are in contact laterally with 2 scales instead of the normal single scale. The only other North American members of the genus belong to the "Mocoa" group of Taylor (*loc. cit.*) and are characterized by a single frontoparietal, and normal median subcaudals each of which is in contact laterally with a single scale.

Of the "Oligosoma" group, *laterale* is easily distinguished from others by having the upper tertiary temporal (occasionally split) in contact with the parietal and usually 3 pairs of nuchals. All others of the group have the upper tertiary temporal separated from the parietal by contact of the upper secondary temporal and nuchal (sometime split), and usually 2 or fewer pairs of nuchals. The other four species fall naturally into two groups, one characterized by long limbs that overlap when adpressed, the foreleg reaching the eye, and scale rows usually 28 or 30, sometimes 32 (*silvicolum, caudaequinae*) the other having short limbs failing to overlap or reach the eye, and scale rows usually 26 or 28, sometimes 25 or 30 (*gemmingeri, forbesorum*). Each group is represented by a northern species (*caudaequinae, forbesorum*), having usually one pair of nuchals, separated by a distance of 150 (in the short-legged group) to 300 miles from a southern species having usually two pairs of nuchals. For the most part all four species appear to occupy their ranges to the exclusion of all others of the group, and probably even the other group does not usually (if ever) occur sympatrically. Allopatry in species of this genus in North America seems to be virtually invariable.

One apparent exception to this rule deserves comment. A single short-legged specimen of *L. forbesorum* bears the same data as the series of *caudaequinae* from San Luis Potosí (EHT No. 23887). It agrees well with others of the species (now known also from the type locality at La Placita, Hidalgo, and possibly Río Verde, San

Luis Potosí *) except in scale row count, which is 30 at the middle of the body. Counts and measurements are given in the accompanying table. Possibly some error occurred in recording the locality data for the specimen, but no indication of such error exists in the catalogue, on the tag or in the condition of the specimen.

L. forbesorum has been recorded no nearer the known range of *gemmingeri* than La Placita, Hidalgo; the nearest locality known for *gemmingeri* is Tequeyutepec, Veracruz, about 150 miles distant. They occupy much the same habitat, both occurring at relatively high elevations. Localities recorded for *gemmingeri* are: *Oaxaca:* "Tehuantepec,†" 17 mi. N. Niltepec, Ixcuintepec, Tres Cruces, San José Manteca, Cafetal Concordia; *Veracruz:* Jalapa, Orizaba, La Perla, Tequeyutepec; *Hidalgo:* Zacualtipan.‡

All of the differences between these are relatively minor and the curves of variation either are known to overlap or assuredly can be expected to do so. The differences are: number of nuchals (*gemmingeri* usually 2 pairs, *forbesorum* usually 1 pair, the number somewhat variable in both ¶); lateral light line along head and neck (poorly defined in *gemmingeri,* fairly well defined in *forbesorum*); axilla-groin/snout-vent percentage (59% in *gemmingeri,* 56% in *forbesorum*); maximum snout-vent length (65 mm. in *gemmingeri,* 54 mm. in *forbesorum*).

In view of the fact that these two forms occur in the same habitat, in areas known to be closely approximated if not actually adjacent, and differ incompletely, it is not unreasonable to regard them as subspecies (*Leiolopisma gemmingeri gemmingeri* (Cope) and *Leiolopisma gemmingeri forbesorum* Taylor).

The long-legged species, *silvicolum* and *caudaequinae,* differ from each other to a somewhat greater degree than the preceding races do from each other (see *Comparisons*). Unfortunately only the type and paratype of the arboreal *silvicolum* have been described in detail; but little information is available for the specimens from Oaxaca. The known degree of difference undoubtedly will be altered by larger series. *L. silvicolum,* known only from San José de Gracia, Veracruz, and Cuicatlán, Oaxaca, does not so clearly occupy

* This specimen (U. S. Nat. Mus. No. 32372), labeled simply "Rio Verde" (presumably San Luis Potosí, but not certainly) cannot now be found.

† Undoubtedly in reference to the area, or Isthmus; the species does not occur at or near the city of this name.

‡ Neither Doctor Taylor nor I have seen this specimen (a Cope record); if correctly assigned it brings the ranges of the two species much closer, into the same range. Even if referable to *forbesorum,* the result is the same so far as range approximation is concerned.

¶ Nuchals on the two sides 0-1 to 3-3 in 21 *gemmingeri,* 89% 1-2 or more (0-1, one; 1-1, one; 1-2, three; 2-2, twelve; 2-3, two; 3-3, two); nuchals 0-0 to 2-3 in 12 *forbesorum,* 88% 1-1 or less (0-0, one; 0-1, two; 1-1, seven; 2-2, one; 2-3, one).

the same habitat as *caudaequinae* of Nuevo León and San Luis Potosí, although all these localities are on the Atlantic drainage and at relatively low elevations. That these forms, like those of the short-legged group, may actually be subspecies is quite possible, but information currently available does not at the present time warrant assumption of subspecific status.

KEY TO MEXICAN MEMBERS OF THE "OLIGOSOMA" GROUP OF LEIOLOPISMA

1. Upper tertiary temporal (occasionally split) in contact with parietal; usually 3 or more pairs of nuchals ..... *laterale*
   Upper tertiary temporal separated from parietal by contact of upper secondary temporal and nuchal; usually less than 3 pairs of nuchals 2
2. Limbs, when adpressed, touching or overlapping in adults, forelimb reaching rear corner of eye; scale rows at middle of body often 30 or 32 3
   Limbs, when adpressed, separated from each other by 1 or more scale lengths; scale rows at middle of body rarely 30 and apparently never 32 4
3. Usually one pair of nuchals or less; lamellae under 4th toe 19 or fewer; dorsolateral light stripe continuous ..... *caudaequinae*
   Usually two pairs of nuchals; lamellae under 4th toe 20 (constant?); dorsolateral light stripe dark spotted, interrupted ..... *silvicolum*
4. Usually nuchals on the two sides 1-2 or more (89%); lateral light line along head and neck poorly defined; axilla-groin/snout-vent percentage 59; 65 mm. maximum snout-vent measurement ..... *gemmingeri gemmingeri*
   Usually nuchals on the two sides 1-1 or less (88%); lateral light line along head and neck fairly well defined; axilla-groin/snout-vent percentage 56; 54 mm. maximum snout-vent measurement ..... *gemmingeri forbesorum*

TABLE OF VARIATION IN LEIOLOPISMA*

Number	10131	23892	23886	23887
Sex	♂	♂	♀	♀
Snout to vent	49.0	47.0	49.0	52.0
Snout to eye	3.5	3.6	3.4	3.3
Snout to ear	9.0	9.0	8.3	8.5
Snout to foreleg	18.0	17.6	17.0	17.5
Eye to foreleg	11.8	11.3	11.3	11.0
Axilla to groin	25.8	24.0	26.5	30.3
Tail	....	71.0	78.0	....
Head width	7.1	6.7	6.8	6.2
Head length to nuchal	8.7	8.7	8.3	8.2
Arm	11.3	11.5	11.0	10.5
Leg	17.8	17.5	16.5	16.2
Longest toe	7.0	6.6	6.2	6.1
Scales behind ear	35	36	38	38
Scales around neck	30	30	32	32
Scales 2 mm. behind axilla	35	35	36	35
Scales about middle of body	28	28	30	30
Scales in row from parietal to rear of thighs	63	61	62	70
Lamellae under 4th toe	17	17	18	18
Legs overlapping by scales	3	7	0	–8
Nuchals	1–2	1–2	1–1	1–1
Anterior nuchal contacting upper 3-2 temporal,	0–+	0–+	0–+	0–+
Anterior nuchals separated from each other	0	0	+	0

* No. 10131, holotype, Nos. 23886, 23892, paratypes, of *L. caudaequinae*; No. 23887, *L. g. forbesorum* from the same locality as the paratypes of the preceding. Measurements in mm.

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Notes on a Small Herpetological Collection from Guerrero

BY

CHARLES W. HALL

ABSTRACT. A collection of snakes and lizards made in the vicinity of Chilpancingo, Guerrero by W. Wilmot Brown is reported. A single new subspecies, *Coniophanes piceivittis taylori* is described.

This paper is based on a small collection of Mexican reptiles acquired by the Kansas University Museum of Natural History from Mr. W. Wilmot Brown. The collecting was done within a 15 km. radius of Chilpancingo, Guerrero. Unfortunately neither exact localities nor approximate elevations are appended but undoubtedly certain specimens came from considerably higher elevations than the city itself. Chilpancingo is located on the Mexico-Acapulco Highway at an elevation of approximately 1380 meters. The city lies on the southern drainage of the Sierra Madre del Sur. The famous collecting locality, Omilteme, (elevation 2460 meters) is located about ten kilometers west of Chilpancingo.

To the west of the city, the mountains of the Sierra Madre del Sur range rise rapidly to reach a maximum elevation of 3700 m. and extend westward for about 275 km. where the range terminates at the Río Balsas. To the eastward the mountains are somewhat lower than at Chilpancingo. This low pass divides the Sierra Madre del Sur from its extension into Oaxaca. The range is separated from the Mexican Plateau on the north by the Balsas Basin and is isolated on the south by the Pacific Ocean.

It is in this area that a great number of endemic species are found. Taylor * has reported 64 endemic species of reptiles and Amphibia in this region (1940). The most surprising character of the fauna has to do with the absence of all salamanders save for what is regarded

* Taylor, E. H., "Island" Faunas on the Mexican Plateau; Proc. Eighth Amer. Sci. Cong., vol. III, Biol. Sci., pp. 503-504.

as the most primitive Mexican plethodontid, *Pseudoeurycea belli*. One can reasonably account for the absence of other forms of plethodontids only by postulating salt water isolation for the area for a considerable period of time, as it hardly seems possible that the Balsas Basin could act as such a barrier. To what extent geological evidence will bear this out, I do not know.

The following species are present in this collection:

SAURIA

Barisia gadovii gadovii (Boulenger)

SERPENTES

Leptotyphlops maximus Loveridge
Drymarchon corais rubidus Smith
Elaphe chlorosoma (Günther)
Lampropeltis doliata blanchardi Stuart
Masticophis flagellum lineatus (Bocourt)
Salvadora mexicana (Duméril, Bibron, and Duméril)
Storeria storerioides (Cope)
Thamnophis chrysocephalus (Cope)
Thamnophis eques eques (Reuss)
Trimorphodon latifascia Peters
Leptodeira maculata (Hallowell)
Coniophanes piceivittis taylori subsp. nov.
Sonora michoacanensis michoacanensis (Dugès)
Oxybelis auratus (Bell)

SYSTEMATIC REPORT

Barisia gadovii gadovii (Boulenger)

Gerrhonotus gadovii Boulenger, 1913, Ann. Mag. Nat. Hist., ser. 8, vol. 12, p. 564.
Barisia gadovii gadovii Tihen, Univ. Kansas Sci. Bull., vol. 33, 1949, pp. 230-231.

Three specimens of *Barisia gadovii gadovii* (KUMNH Nos. 23792, 23793, and 23794) are said to have been collected in "the vicinity of Chilpancingo," Guerrero. However one supposes that they came from the mountain west of, and at a higher elevation than the city itself. The type locality, Omilteme, Guerrero, is at an elevation of 2460 meters and about 10 kilometers west from Chilpancingo.

Examination of these specimens revealed the following data: postrostral absent in specimens No. 23793 and No. 23794, but present in specimen No. 23792 separating the two supranasals; a small pair of supranasals separating internasals from nasals; a pair of canthals lying on either side and broadly in contact with frontonasal; three lateral supraoculars; five medial supraoculars; supraciliaries 5-4 in No. 23792, 5-5 in No. 23793, 4-4 in No. 23794; one pre-

ocular; two suboculars; two postoculars; four primary and four secondary temporals; supralabials 9-10 in each specimen; infralabials 8-8 in Nos. 23792 and 23794, 7-8 in No. 23793; postmental paired, followed by three large pairs of chinshields.

Further data is given in the table.

SCALE COUNTS AND MEASUREMENTS (IN MM.) OF BARISIA GADOVII GADOVII (Boulenger)

No.	23792	23793	23794
Snout to vent	66	73	83
Tail length	115	138	119
Right forelimb	15	16	17
Left forelimb	17	17	17
Right hindlimb	20	21	22
Left hindlimb	21	22	23
Snout to ear	14	17	16
Axila to groin	37	39	48
Snout to forelimb	23	25	26
Parietal to above anus	44	48	51
Number of caudals	79	90	65
Dorsal scales at mid-body	16	16	18
Ventral scales at mid-body	12	12	12

Leptotyphlops maximus Loveridge

Leptotyphlops maximus Loveridge, Proc. Biol. Soc. Wash., vol. 45, 1932, pp. 151-152; Taylor, Copeia, 1939, No. 1, pp. 4-5, figs. 3-4; Klauber, Trans. San Diego Soc. Nat. Hist., vol. 9, 1940, pp. 120-122, map 1.

There is one specimen of this large blind snake in the collection, which gives the following data: supralabials 2; infralabials 3; 14 scale rows around body; ventrals 219; caudals 15; anal single; total length 210 mm; tail length 9 mm; tail length contained in body length 23 1/3 times.

In alcohol the specimen is brown above with the underside pink. A casual glance gives one the impression that the scales contain a pattern fringing their edges. However on closer inspection, the scale edge is seen not to coincide with the pattern. Upon removal of the outer epidermis, there is seen the uncornified part of the scale lying beneath. It appears as if the outer epidermis has grown caudad from the deeper portion of the underneath scale, its posterior edge becoming free as occurs in the growth of a fingernail.

Drymarchon corais rubidus Smith

Drymarchon corais rubidus Smith, Journ. Washington Acad. Sci., vol. 31, 1941, pp. 474-476, map fig. 2 (part).

Two specimens in this collection are referred to this subspecies (K.U.M.N.H. Nos. 23799 and 26728). Head scales normal; supralabials eight, the antepenultimate labial in contact with the temporal

but not with the postocular; one preocular; two postoculars; temporals 2-2; anal entire.

The color is in accord with that given by Smith (*loc. cit.*) except the female, which I judge to be half-grown, has retained a pattern on the dorsal surface. The pattern, a series of pink chevronlike bars, one scale row in width, commences on the nape and continues throughout the body but disappears on the tail. The bands are not discrete, but are infiltrated with the black color. The smaller, male specimen is uniformly black on the dorsal surface with only a faint suggestion of a pattern.

DATA ON DRYMARCHON CORAIS RUBIDUS Smith

No.	Sex	Scale formula	Ventrals	Caudals	Infra-labials	Total length	Tail length
23799	♀	17–17–15	198	69	8–9	1500	260
26728	♂	19–17–15	197	59	8–8	1130	185

Elaphe chlorosoma Günther

Coluber chlorosoma Günther, Biologia Centrali-Americana, Rept., 1894, pp. 115-116, pl. 41.
Elaphe chlorosoma Stejneger and Barbour, A Checklist of North American Amphibians and Reptiles, ed. 1, 1917, p. 82; Smith, Copeia, 1941, No. 3, pp. 134-135.

There are three specimens of *Elaphe chlorosoma* in this collection, two adults and fortunately one juvenile, KUMNH Nos. 23781-23783. The juvenile has a somewhat larger count of spots on the body than those mentioned by Smith (*loc. cit.*). He reported 57 spots, this one having approximately 66. The fact that this juvenile and two adults were collected from the same general area, seem to confirm in some measure the opinion of Smith (*loc. cit.*) that *Elaphe mutabilis* (Cope) represents the juvenile pattern of *chlorosoma*. However, as shown in the table, the juvenile has a lower ventral count and higher caudal count.

The three specimens are identical in the following characteristics: infralabials 10; preoculars 1; postoculars 2; loreal 1; temporals 3, 4; chinshields 2; anal divided. The wide range in the ventral count found in these three specimens (247-278, a difference of 31 scales) is especially noteworthy and may suggest that two forms are involved.

DATA ON ELAPHE CHLOROSOMA Günther

No.	Sex	Scale formula	Ventrals	Caudals	Total length	Tail length	Supra-labials
23781	♀	33–35–25	267	88	1260	210	9–10
23782	♀	31–35–23	278	93	1170	210	8
23783	♂	31–35–23	247	108	380	80	8

Lampropeltis doliata blanchardi Stuart

Lampropeltis polyzona blanchardi Stuart, Occ. Pap. Mus. Zool. Univ. Michigan, No. 309, 1935, pp. 1-6. Taylor, Univ. of Kansas Sci. Bull., vol. 26, 1939 (1940), p. 467, pl. 49.
Lampropeltis triangulum blanchardi Dunn, Occ. Pap. Mus. Zool. Univ. Michigan, No. 353, 1937, p. 8.
Lampropeltis doliata blanchardi Klauber, Copeia, No. 1, pp. 10-11, 1948.

Nine specimens of *Lampropeltis doliata blanchardi* Stuart are in this collection. They are identical in the following characteristics: supralabials 7, infralabials 8, preoculars 1, postoculars 2, temporals 2 + 3, chinshields 2, loreal 1, anal single.

The snout is totally black with no evidence of a white snout band. These specimens show a slightly higher average ventral count than that given by Smith,* 212 as compared to 208.

LAMPROPELTIS DOLIATA BLANCHARDI Stuart

No.	Sex	Scale formula	Ventrals	Caudals	Total length	Tail length
23772	♂	21–21–19	211	51	650	93
23773	♀	21–19–19	216	46	740	102
23774	♀	21–21–19	209	47	370	52
23775	♀	21–19–19	218	50	900	129
23776	♂	21–21–19	216	28	780	75
23777	♂	21–19–19	210	54	900	132
23778	♂	21–21–19	211	53	870	130
23779	♀	21–21–19	212	49	810	109
23780	♀	21–21–19	211	49	550	84

Masticophis flagellum lineatus (Bocourt)

Bascanion lineatus Bocourt, Mission scientifique au Mexique et dans l'Amérique centrale; Etude sur les reptiles, livr. 12, 1890, pp. 700-701, pl. 48, fig. 1.
Masticophis lineatus Ortenburger, Occ. Pap. Mus. Zool. Univ. Michigan, No. 139, 1923, p. 2; Mem. Univ. Michigan Mus. Zool., vol. 1, 1928, pp. 134-138, p. 125.
Coluber striolatus Mertens, Zoologica (Stuttgart), vol. 32, 1934, p. 190 (substitute name for *Coluber lineatus* (Bocourt), a secondary homonym of *Coluber lineatus* Linnaeus (*Lygophis lineatus*).

A series of six specimens was obtained in the Chilpancingo region (KUMNH Nos. 24104-24109). The dorsal color, at a glance, appears to be bluish gray, but upon closer inspection of the specimens, the dorsal scales are seen to be tipped with black and small cream-colored lines are faintly discernible. The venter is cream with the outer margins of each ventral scale taking on the gray dorsal color. The lips and chin are heavily mottled. The supralabials of each specimen are 8-8, with the fourth and fifth entering the orbit; preoculars 2; postoculars 2; loreal 1; anal divided; scale formula 19-17-13.

* Smith, H. M., Proc. of the Rochester Acad. Sci., Sept. 10, 1942, vol. 8, pp. 199-260.

DATA ON MASTICOPHIS FLAGELLUM LINEATUS (Bocourt)

No.	Sex	Ventrals	Caudals	Infra-labials	Temporal	Total length	Tail length
24104	♂	192	129	10	2–3	1570	460
24105	♂	194	77	10	2–3	1460	300
24106	♂	194	108	10–11	2–2 2–3	1440	380
24107	♂	192	129	10	2–2 2–2	1450	440
24108	♀	193	97	10	2–3	1340	340
24109	♀	195	116	10–11	2–2 2–3	1235	350

Salvadora mexicana (Duméril, Bibron, and Duméril)

Zamenis mexicanus Duméril, Bibron, and Duméril, Erpétologie générale, vol. 7, pt. 1, 1854, pp. 695-696.—Bocourt, Mission scientifique au Mexique et dans l'Amérique Centrale; Etude sur les reptiles, livr. 11, 1888, p. 664, pl. 46, fig. 5.

Salvadora mexicana Günther, Ann. Mag. Nat. Hist., ser. 3, vol. 12, 1863, p. 349.—Bogert, Copeia, 1939, No. 3, pp. 144-145.

There is only one specimen of *Salvadora mexicana* in this collection (KUMNH No. 23784). The specimen is an adult male, measuring 1213 mm. total length, with a tail length of 460 mm. In alcohol the ground color is cream with four longitudinal brown or black stripes running almost the full length of the snake, fading out only near the tip of the tail and interrupted in the neck regions by eight or ten cross bars. There are some black spots on the outer margins of the ventrals in the anterior third of the body. The following scale characters are in evidence: scale formula 17-17-13, ventrals 192, caudals 140; supralabials 9, infralabials 10, preoculars 1, postoculars 2, temporals 2 + 2, chinshields 2, loreal 1, anal divided.

Storeria storerioides (Cope)

Tropidoclonium storerioides Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 17, 1865, pp. 190-191.

Storeria storerioides Garman, Mem. Mus. Comp. Zool., vol. 8, No. 3, 1883, p. 29; Taylor and Smith, Univ. Kansas Sci. Bull., vol. 25, 1938 (1939), pp. 249-251, fig. 3 (head only); Smith, Proc. U. S. Nat. Mus., vol. 93, 1943, p. 473.

Hemingenius variabilis Dugès, Proc. Amer. Philos. Soc. vol. 25, 1888, pp. 182-183, fig. 2 (type locality, Guanajuato; type in Mus. Alfredo Dugès, Univ. Guanajuato, Mexico).

There is one specimen (KUMNH No. 23788) of *Storeria storerioides* in this collection, having the following characteristics: scale formula 15-15-15; ventrals 128; caudals 50; anal divided; supralabials 7-6; infralabials 7; loreal 1; preoculars 2; postoculars 3; temporals 1 + 2; chinshields 2 pairs; total length 270 mm; tail length 60 mm; coloration reddish brown with dark brown chevron-like bands faintly discernible on the upper 1/3 of the body.

Thamnophis chrysocephalus (Cope)

Eutaenia chrysocephalus Cope, Proc. Amer. Philos. Soc., vol. 22, 1884 (1885) pp. 173-174.
Thamnophis chrysocephalus Smith, Zoologica, vol. 27, 1942, p. 104; Proc. U. S. Nat. Mus., vol. 93, 1943, pp. 478-479.
Thamnophis eburatus Taylor, Herpetologica, vol. 1, 1940, pp. 187-189, pl. 19, text fig. 2 (type locality, Cerro San Felipe, Oaxaca; type, E. H. Taylor-H. M. Smith coll. No. 5556).

This collection contains one specimen of *Thamnophis chrysocephalus* (KUMNH No. 23785). It is a female measuring 580 mm. total length and 150 mm. tail length. On the upper surface the color, in alcohol, is a midnight blue. The venter is blue, spotted with pink. The underside of the chin and infralabials is an immaculate pink. The supralabials are also spotted with pink.

Thamnophis eques eques (Reuss)

Coluber eques Reuss, Zool. Misc., 1834, pp. 152-155, pl. 8, fig. 2.
Thamnophis eques eques Gloyd and Smith, Bull. Chicago Acad. Sci., vol. 6, 1942, p. 234; Smith, Zoologica, vol. 27, 1942, pp. 106-108.
Thamnophis cyrtopsis cyclides Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 13, 1861, pp. 229-230 (type locality unknown, "Cape St. Lucas"; type, USNM No. 5023).
Eutaenia pulchrilatus Cope, Proc. Amer. Philos. Soc. vol. 22, 1884 (1885), p. 174 (type locality, Guanajuato; type USNM No. 9899).

Two specimens collected in the Chilpancingo region are referred to this subspecies (KUMNH Nos. 23797 and 23798).

Head scales normal; supralabials eight, the fifth and sixth in contact with lower postocular; infralabials eleven, five in contact with anterior chinshields; one preocular; two postoculars; anal single; scale formula 19-19-17. A very distinct median light stripe, involving only the vertebral row of scales, runs the entire length of the body; dark spots present on scales below the lateral light line, at least anteriorly, visible without spreading the scales.

DATA ON THAMNOPHIS EQUES EQUES

No.	Sex	Ventrals	Caudals	Total length	Tail length
23797	♀	151	85	410	110
23798	♂	150	83	810	210

Trimorphodon latifascia (Peters)

Trimorphodon biscutata latifascia Peters, Monatsb. Akad. Wiss, Berlin, 1869, p. 877.
Trimorphodon latifascia Taylor, Univ. Kan. Sci. Bull., vol. 25, 1938 (1939), pp. 364-365, pl. 36, fig. 2; and vol. 26, 1939 (1940), p. 479, pl. 52; Smith, Proc. U. S. Nat. Mus., vol. 91, 1941, p. 160, map, fig. 38.

There are four Guerrero specimens of this rare *Trimorphodon* in the collection, two adult females, one adult male, and one juvenile. Heretofore the known range was Morelos and southeastern Puebla.

The only discernible difference between these specimens and the group described by Taylor* is in the number of spots. The num-

* Taylor, E. H., Univ. Kan. Sci. Bull., vol. 26, 1939 (1940), p. 479, pl. 52.

bers recorded by Taylor are 13-15 on the body and 5-7 on the tail, with the highest total (body + tail) being 22, and the lowest total being 19. The four specimens in this collection have a range of 15-17 spots on body and 7½-10½ on the tail, with a high total of 27½ and a low total of 23. The ground color of the adults is tan, (on the juvenile, pink), the spots themselves ranging from grey in their middle to black at their periphery.

DATA ON TRIMORPHODON LATIFASCIA (Peters)

Number	24100	24101	24102	24103
Sex	♀	♀	♂	♀
Ventrals	218	215	215	215
Caudals	66	74	78	59
Scale formula	23–23–16	23–23–17	23–23–16	23–23–16
Supralabials	8–9	8–8	8–10	8–8
Infralabials	13–13	12–12	13–13	12–13
Loreals	3	3	3	3
Preoculars	3	3	3	3
Postoculars	3	3	3	3
Spots on body	17	15	17	16
Spots on tail	8	8	10½	7½

Leptodeira maculata (Hallowell)

Megalops maculatus Hallowell, Proc. Acad. Nat. Sci. Philadelphia, vol. 12, 1860 (1861), p. 468.

Leptodeira septentrionalis maculata Dunn, Proc. Nat. Acad. Sci., vol. 22, 1936, p. 697.

Leptodeira maculata Taylor, Univ. Kansas Sci. Bull., vol. 25, 1938 (1939), pp. 337-342, figs. 6-7, pl. 31, fig. 1, pl. 32, pl. 33, figs. 1-3; Smith, Proc. U. S. Nat. Mus., vol. 93, 1943, pp. 440-441.

Leptodeira personata Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 20, 1868 (1869), p. 310 (type locality, Mazatlán, Sinaloa).

There is a single male specimen of *Leptodeira maculata* in the collection (KUMNH No. 23786). The specimen has the following characteristics: scale formula 21-23-17; ventrals 186; caudals 79; anal divided; supralabials 8; infralabials 9-10; preoculars 2; postoculars 2; temporals 1 + 2; chinshields 2; total length 580 mm; tail length 130 mm. There are 32 black blotches on the body and 17 on the tail. The dorsal blotches on the body reach the second or third scale row, the majority reaching only the third. In alcohol the ground color is tan to gray with black bands.

Coniophanes piceivittis taylori, subsp. nov.

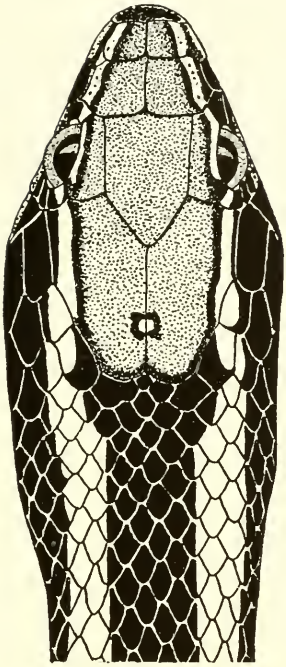
Type.—EHT-HMS No. 23523, Agua del Obispo, Gro., 1940, E. H. Taylor collector.

EXPLANATION OF PLATE XXIV

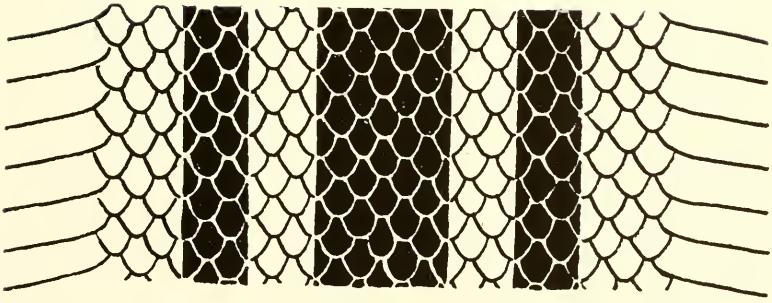
FIG. 1. *Coniophanes piceivittis taylori subsp. nov.* Type specimen. Dorsal view of head. Actual head width 8 mm.

FIG. 2. *Coniophanes piceivittis taylori.* Dorsal color pattern (enlarged, diagrammatic).

FIG. 3. *Coniophanes piceivittis piceivittis* Cope. Dorsal color pattern (enlarged, diagrammatic).



1



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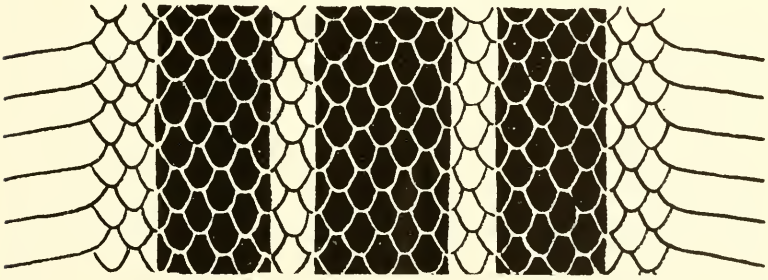

3

Paratypes.—EHT-HMS Nos. 23524, 8 m. east of Chilpancingo, Gro., E. H. Taylor collector; 5197, Km 357 on Mexico-Acapulco Highway, Gro., E. H. Taylor collector; KUMNH No. 23789, Chilpancingo, Gro., W. W. Brown collector.

Diagnosis.—Similar to *Coniophanes piceivittis piceivittis* in general characters but differing in having an elongate frontal, its length equal to 1¼ times distance of frontal from tip of snout (in *p. piceivittis* shorter than its distance to tip of snout) and with somewhat shorter prefrontals; color pattern in general similar to *p. piceivittis* but differing in having head brown above instead of black; in having a small cream-colored, black-bordered ocellus (See Fig. 1) on parietals (no such spot present in *p. piceivittis*). The inferior lateral stripe commencing on middle of fourth scale row and occupying two and two half scale rows as compared with *p. piceivittis* which has the lateral stripe commencing on middle of third scale row and occupying three and two half scale rows. Separating lateral stripe from median dorsal stripe is an intervening space of cream ground color, which occupies two and one half scale rows as compared to 1½ scale rows in *p. piceivittis;* median dorsal black stripe occupies five and two half scale rows, while that of *p. piceivittis* with six and two half-rows, or seven complete scale rows (See Fig. 2).

Description of type.—Rostral 1½ times as wide as high, plainly visible from above; internasals two-thirds length of prefrontals; prefrontals as wide as long; frontal 1¼ times as long as distance from frontal to tip of snout; parietals 1½ times as long as the distance from snout to frontal. Nasal divided, posterior part larger; loreal squarish, a little longer than high; two preoculars, upper large, lower small; two postoculars, the upper being the larger; temporals 1 + 2 + 3, the anterior temporal bordering both postoculars. Supralabials eight, ascending order of size: 2, 3, 1, 4, 5, 6, 8, 7; fourth and fifth bordering the eye; infralabials nine, first four bordering the first pair of chinshields; scale formula 21-25-19; all scales smooth, except (in male specimens) keeled scales present on the first two scale rows on sides above anal region; scales without apical pits. Ventrals 169, caudals 90; anal divided.

Color.—Pattern consisting of three longitudinal black stripes on a ground color of cream, the stripes commencing on snout and continuing to within the second or third scale from the tip of the tail. Lateral black stripe commencing in the middle of the fourth scale row and occupying two and two half scale rows; separating lateral from medial dorsal stripe is an intervening space of two and one-

half scale rows of cream ground color; median dorsal black stripe occupies five and two half scale rows. Moving anteriorly, the median dorsal black stripe becomes brown on entering the parietal scales and continues as a brown stripe to the rostrum; a small cream colored ocellus with a black periphery lying in the center of the parietal region; from eye forward, intervening light stripe peppered with black spots. Venter immaculate; dark brown or black spots on chin and infralabials.

Measurements in mm. — Head length (snout to jaw angle) 14; head width 8; total length 340; tail length 98.

Variation.—The paratypes agree in most characters except in scale counts. A table is appended to show the variations.

Remarks.—The geography of this area does not differ greatly from that in which the typical subspecies is known to occur in Oaxaca, Chiapas and in northern Central America. The specimen referred to by Bailey,* reported to have been collected in Costa Rica, must be verified.

The specimens of *p. taylori* which I have before me are somewhat smaller than the specimens of *p. picivittis* which I have examined. Whether or not this is due to the age of the specimens, I do not know. All were collected at an altitude of from 800-1400 meters elevation.

DATA ON CONIOPHANES PICEIVITTIS TAYLORI

Museum	EHT-HMS	EHT-HMS	EHT-HMS	KUMNH
No.	23523	23524	5197	23789
Sex (or age)	♂	♀	Juv.	♀
Scale formula	21–25–19	23–25–19	23–21–25–A	23–25–19
Ventrals	169	171	165	170
Subcaudals	90	87	85	78–
Supralabials	8–8	8–8	8–8	8–8
Infralabials	9–9	9–10	10–10	9–10
Total length (mm.)	340	330	188	240
Tail length (mm.)	98	85	48	58

Sonora michoacanensis michoacanensis (Dugès)

Contia michaocanensis Dugès, in Cope, Proc. Amer. Philos. Soc., vol. 22, 1884 (1885), pp. 178-179 ("Michoacán").

Sonora michoacanensis michoacanensis Stickel, Proc. Biol. Soc. Washington, vol. 56, 1943, pp. 113-116.

Sonora erythura Taylor, Herpetologica, vol. 1, 1937, pp. 69-71, pl. 6, fig. 1, (type locality, 10 mi. south of Taxco, Guerrero).

There are two specimens of *Sonora michoacanensis michoacanensis* in this collection (KUMNH Nos. 23790, 23791). Scale rows 15-15-15; supralabials 7; infralabials 7; preoculars 1; postoculars 2;

* Bailey, Joseph R., Mich. Acad. of Sci., Arts and Letters, vol. 24, part II; 1938, pub. 1939, pp. 29, 30, 31.

chinshields 2; loreal present; anal divided. Anteriorly on the body the color is arranged in triads composed of two black bands separated by a white band of about the same width. An orange band two or three times as wide as either the black or the white bands separates these from the next black and white triad. Near the middle of body, the orange gives way to black, presenting black and white diads on the posterior part of the body. However occasionally some orange may be visible in the black annuli on the ventral surface. The tail is solid orange.

Taylor (*loc. cit.*) has described this Guerrero species under the name of *Sonora erythrura,* having compared his specimen with the figures given by Günther in (1895) Biologia Centrali-Americana. Reptilia and Batrachia, pl. 36, fig. C, named *Homalocranium michoacanense* and found it different. He was unaware that these specimens of Günther actually represented an undescribed form, which has since been named *Sonora michoacanensis mutabilis* by Stickel (*loc. cit.*) (pp. 116-117).

DATA ON SONORA MICHOACANENSIS MICHOACANENSIS

No.	Sex	Ventrals	Caudals	Temporals	Total length	Tail length	Annuli
23790	♀	176	41	1 2	290	50	16
23791	♀	177	42	1 1	340	60	15

Oxybelis auratus (Bell)

Dryinus auratus Bell, Journ. Zool., vol. 2, 1825, pp. 324-326, pl. 12; "Mexico." (It appears that *auratus* antedates *acuminatus* Wied. The specific and subspecific relationship of Mexican forms is still open to question.)

Oxybelis aeneus auratus Bogert and Oliver, (part), Bull. Amer. Mus. Nat. Hist., vol. 83, 1945, pp. 381-392, figs. 10-11.

Coluber acuminatus Wied, Abbildungen zur Naturgeschichte Brasilien, Lief. 14, 1822 (1830?), pl. 1.

Oxybelis acuminatus Steindachner, Reise der österreichischen Fregatte *Novara* . . . , Reptilien, 1867, p. 72. Boulenger, Catalogue of the Snakes in the British Museum, vol. 3, 1896, pp. 192-193. Bocourt, Mission Scientifique au Mexique et dans l'Amérique centrale; Etude sur les reptiles, livr. 15, 1897, pp. 838-840, pl. 65, fig. 4. Taylor, Univ. Kansas Sci. Bull., vol. 27, 1941, p. 138, pl. 6, figs. 7, 8, 9.

Oxybelis fulgidus Crimmins (*nec* Daudin), Copeia, 1937, No. 4, p. 233.

Two specimens obtained from the Chilpancingo region referred to this species, give the following data: preoculars 1, postoculars 2, supralabials 8-8, scale formula 17-17-13. The coloration is normal for the species.

DATA ON OXYBELIS AURATUS (Bell)

No.	Sex	Ventrals	Caudals	Infra-labials	Body length	Tail length
23795	♀	195	177	9– 9	1235	500
23796	♂	192	184	9–10	1220	510

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A New Subspecies of the Mexican Moccasin, *Agkistrodon bilineatus* *

W. Leslie Burger and William B. Robertson

Two specimens of *Agkistrodon bilineatus* Günther from northeastern Mexico represent a distinct subspecies for which no name has yet been proposed. The localities where these specimens were collected are in a semi-arid area covered with desert shrub vegetation, as contrasted to the humid, lowland jungle where *A. bilineatus* is usually found. The nearest locality records for typical *A. bilineatus* are several hundred miles distant from those known for the new subspecies.

Our attention was first called to this interesting situation by Dr. Edward H. Taylor, who collected the specimen which we have designated holotype of the new subspecies, and to whom we are indebted for permission to study it and other specimens of the species in his collection. For advice and assistance, including the loan of specimens, we wish in addition to thank Dr. Howard K. Gloyd, Dr. Hobart M. Smith, and Mr. Clifford H. Pope.

We have used Gloyd and Conant's (1943) scheme of description of races of *Agkistrodon contortrix* as a model for the following description.

Agkistrodon bilineatus taylori new subspecies†

Agkistrodon bilineatus Taylor, Univ. Kansas Sci. Bull., vol. 26, no. 14, 1940, p. 486.—Schmidt and Owens, Zool. Ser. Field Mus. Nat. Hist., vol. 29, no. 6, 1944, p. 113.

Holotype.—E. H. Taylor Collection No. 5514, a young male from km. 833, 21 kilometers north of Villagrán, Tamaulipas, collected alive by Edward H. Taylor on June 9, 1938, on the highway pavement about dark. *Paratype.*—Chicago Natural History Museum No.

* Contribution from the Museum of Natural History and the Department of Zoology, University of Illinois, Urbana, Illinois.

† Named for Dr. Edward H. Taylor in recognition of his many contributions to our knowledge of the Mexican herpetofauna.

28794, adult male from south of Linares in the region of the boundary between the state of Tamaulipas and Nuevo Léon, Mexico.‡ The exact locality is unknown but undoubtedly is no more than a few miles from the type locality.

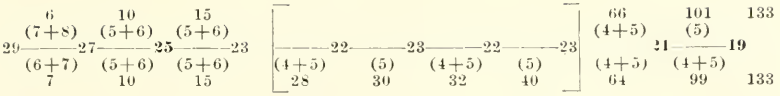
Diagnosis.—This subspecies differs from *Agkistrodon bilineatus bilineatus* in the following respects: (1) lower light line on side of head not bordered below by a dark line posterior to the second supralabial; (2) fewer subcaudals, 51-54 in males; and (3) a pattern of dorsal crossbands which remains distinct in adults.

Description of holotype.—Head shields arranged as in *Agkistrodon bilineatus bilineatus*: paired and bilaterally symmetrical internasals, prefrontals, supraoculars, and parietals, and a single rostral and frontal; posterior border of parietals irregular and broken by several sutures which extend a short distance anteriorly. Nasals 2, the anterior large and crescent-shaped, the posterior smaller and approximately square with much rounded corners. Loreal about as long as high, smaller than upper preocular and about the same size as posterior nasal. Three preoculars, the uppermost larger, the middle one forming the upper and posterior borders of pit, and the lowermost very small. Separated from orbit by the last is an elongate scale which forms the lower border of pit. One large subocular and two postoculars. Supralabials 8, the first smaller, irregularly quadrangular, and lying entirely below anterior nasal; the second larger and elongated upward to form anterior border of pit; the third, fourth, fifth, sixth, and seventh largest and about equal in size; the posterior part of third and most of fourth beneath eye; the eighth shorter than others. Infralabials 11 on each side, the anterior pair meeting immediately posterior to mental. Temporals irregular, 4 to 6 in each vertical row. A single pair of enlarged chinshields followed by four pairs of scales, the last which is separated from the labials by 4 longitudinal rows of scales on each side.

Dorsal scales keeled on the back, the keels reduced on the sides and absent from the lower two rows on each side; scale rows odd in number, progressively reducing bilaterally toward the tail as follows:¶

‡ Due to an error in the museum catalogue, locality data for the latter specimen was erroneously recorded by Gloyd and Conant (1943); but the record was subsequently corrected by Schmidt and Owens (1944).

¶ In the following scale count formula the Clark and Inger recount system (1942) is used with several modifications. Changes of an anomalous nature are enclosed in brackets and the number of rows covering the loci where the usual three counts are made are printed in bold-faced type. In a number of specimens the anterior and mid-body counts are the same (this is the case in all instances where only two numbers are in bold-faced type). An abbreviated formula omitting the number of the scale rows involved in each change is used for all except the holotype and paratype.



The ventrals are 133; subcaudals 54, the last 19 divided. The anal is entire but has the posterior left corner almost cut off by a suture extending from the left anterior corner toward the middle of the posterior edge. Terminal spine short and blunt, scarcely protruding beyond the last pair of subcaudals. The snout-vent length is 383 mm. and the tail length, 82 mm.

"Head grayish-black above, more grayish on the sides of head and chin; a yellowish-white line from tip of snout along the canthus rostralis to angle of the jaw, where it joins a line originating on the anterior nasal which runs across the labials and across angle of the jaw; below the white line on labials, the lip is edged with amber-orange; a vertical stripe on rostral which is white with amber-orange center; this connects, when mouth is closed, with a stripe extending back from mental to the posterior chinshields and then bifurcates, the lines continuing back to first widened ventral. The lines are here joined by another white line; two amber-orange lines extend from sixth lower labial diagonally to the bifurcating lines.

"Body generally lavender gray, traversed by lighter gray, irregular, saddle-like blotches, with interrupted amber-orange borders, which join and form a large amber-orange spot low on side; intervening areas may be divided by a very dim medial band, which joins a black, light-edged spot on the ventrals. Belly generally dark with amber-orange spots and reticulations. Tail yellow-green." §

Dark dorsal crossbands 12 in number on the body, the first continuous with the darker portions of the head, the last extending onto the base of the tail, all wide and slightly constricted medially, averaging 10 scales in width on the sides and 8 at the midline. Each anterior and posterior border of the bands fuses with a lateral belly spot. Each band has a slightly lighter median band across the center which expands on the sides to enclose a third lateral ventral spot for each band. This middle lateral spot is usually more extensive than the others, reaching to or beyond the middle of the ventrals and often joining the corresponding spot of the opposite side. Posteriorly the dark ventral coloring becomes extensive and all of the lateral ventral spots tend to be connected. The dark brown ver-

§ Color of the holotype in life, quoted from Taylor (1940, p. 486).

tical band on each side of the light rostral stripe extends posteriorly along the upper lip only to the middle of the second supralabial.

Variation.—The two specimens of *taylori*,° the holotype and paratype, agree closely in coloration and scutellation. The lower light head stripe of the paratype has a dark border only on the first and adjacent third of the second supralabial on the left and on the first supralabial on the right. The dorsal crossbands are distinct, as in the holotype, but slightly narrower averaging 9 scales wide on the sides and 7 scales at the midline. Ventrals are 133 in number, caudals 51, snout-vent length 553 mm., tail length 125 mm., supralabials 8, infralabials 10. The dorsal scale rows are as follows:

11	14	85	106	133
(7+8)	(6+7)	(4+5)	(5)	
27——25——23——21——19				
(7+8)	(6+7)	(4+5)	(5)	
11	11	77	106	133

Discussion.—The two specimens of this subspecies were compared with ten specimens of the typical subspecies from the following localities:|| MEXICO: no definite locality (CNHM 42147, CNHM 56376); *Colima:* no definite locality (CAS 5253), Tecoman (CAS 11333); *Michoacán:* Apatzingan (CNHM 39093), El Sabino, Uruapan (EHT-HMS 5357); *Oaxaca:* Rincón Bamba (EHT-HMS 28019); *Yucatán:* Libre Unión (CNHM 36253), Mérida (CNHM 19425). BRITISH HONDURAS: Belize (CNHM 4196). In addition the summary of the data for 46 specimens of *bilineatus* given by Gloyd and Conant (1943, p. 168) proved very useful.

The dark lower border of the lower head stripe in all of the specimens of *bilineatus* which we have examined extends to at least the sixth supralabial and usually to the seventh or eighth supralabial. This is in marked contrast to the condition in *taylori* in which the dark border does not extend beyond the middle of the second supralabial (see pl. 25).

With one exception the numbers of ventrals and caudals in these specimens of *bilineatus* fall within the ranges given by Gloyd and Conant (1943, p. 168). The numbers of subcaudals of the two males of *taylori*, 54 and 51, fall well below the range in number of subcaudals of male *bilineatus* (59-68). The exception mentioned above, a male *bilineatus* (CNHM 39093) with 69 subcaudals, extends this

° Hereafter the single names *taylori* or *bilineatus* refer to the subspecies unless otherwise indicated.

|| The following abbreviations are used for the collections from which specimens were examined: Chicago Academy of Sciences (CAS), Chicago Natural History Museum (CNHM), Edward H. Taylor-Hobart M. Smith Collection (EHT-HMS).

range slightly. The number of ventrals in both specimens of *taylori*, 133, is well within the range of variation of male *bilineatus*.

In adult *bilineatus* the dorsal crossbands exhibited by juveniles are obscured by the general darkening of the ground color (see Gloyd and Conant, 1943, fig. 11). The dark adult coloration is acquired in this subspecies at a rather small size, probably during the second or third year. A male of *bilineatus* (CNHM 1133), 587 mm. in snout-vent length, shows the typical melanistic coloration. In contrast *taylori* retains distinct cross bands for a longer time, possibly throughout life (see pl. 25). The crossbands of the paratype, with a snout-vent length of 553 mm., are distinct with no indication of becoming obscured. For this reason the color pattern of *A. b. taylori* bears a general resemblance to that of *A. contortrix pictigaster* and of juvenile *A. piscivorus leucostoma*, the geographic ranges of both of which it closely approaches (see Gloyd and Conant, 1943, figs. 10, 13). These three forms also show convergence in number of subcaudals. The exact phylogenetic significance of these trends is not certain. However, it seems very unlikely that the species *bilineatus* through its subspecies *taylori* will be found to intergrade with either the copperhead or cottonmouth.

The specimens available to us do not indicate any subspecific difference in proportionate tail length. Measurements of larger series of both subspecies would be required, as ontogenetic changes in proportionate tail length are obviously involved. Similarly no subspecific differences could be found in the number of dorsal scale rows. To illustrate the variation several abbreviated scale row formulae of *bilineatus* are given below:

CNHM 36258	♀	27	9 / 9	25	13 / 14	23	91 / 89	21	120 / 114	19	138 / 138
CNHM 39093	♂	27	11 / 10	25	14 / 15	23	84 / 85	21	96 / 97	19	132 / 132
EHT-HMS 28019	♂	27	12 / 15	25	23 / 17	23	105 / 104	21	/ 133	20	132 / 132

If the variation in the location of each scale row reduction is noted, no definite difference is apparent between *bilineatus* and *taylori* (see Table 1). The average point of each scale row reduction may be found to be more posterior in *bilineatus* when larger series of each subspecies are examined.

TABLE I.—Ordinal Number of Ventral Where Each Dorsal Scale Row Reduction Occurs *

Subspecies	Scale Row Reduction			
	27 ⇒ 25	25 ⇒ 23	23 ⇒ 21	21 ⇒ 19
A. b. taylori	10–11	11–15	64–85	99–106
A. b. bilineatus	9–15	13–23	84–105	96–133†

* Based on only 2 specimens of *taylori* (both males) and three of *bilineatus* (2 males and 1 female).

† In one specimen no last reduction occurred anterior to the anus on one side.

In the three characteristics mentioned in the diagnosis, *taylori* is apparently completely distinct. Its affinity with *A. bilineatus* is, however, unmistakable. Future collecting will probably reveal intergading populations somewhere in the Atlantic coastal plain between central Tamaulipas and Yucatán. Even in the event that such intergrades fail to appear, we feel that the relatively minor nature of the differences between *taylori* and *bilineatus* indicate existence of a subspecific relationship between them. We are in accord with Mayr's (1947, p. 166-167) opinion that, in the case of forms not known to occur together, the degree of morphological difference associated with reproductive isolation in forms of the same group known to be species should be applied as a yardstick to determine whether the forms in question are best to be considered as species or subspecies. Only in the event that actual overlap without intergradation was found to occur would one be justified in considering *taylori* a distinct species.

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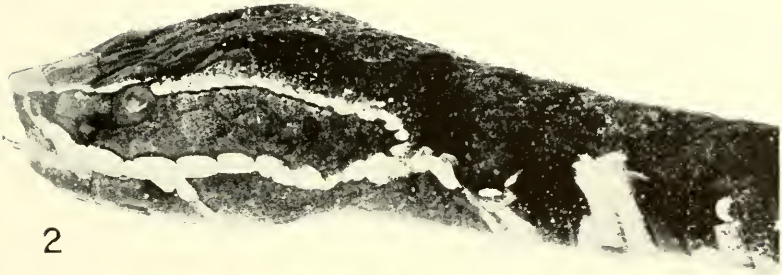

PLATE XXV. FIG. 1. Dorsal view of the holotype of *Agkistrodon bilineatus taylori* subsp. nov. Total 678 mm. E.H.T.-H.M.S. No. 5514. FIG. 2. Lateral view of head of holotype of *A. b. taylori* (enlarged). FIG. 3. Lateral view of head of *Agkistrodon bilineatus bilineatus*, E.H.T.-H.M.S. from El Sabino, Uruapan, Michoacán.

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An Anatomical Study of Certain Salamanders of the Genus Pseudoeurycea

BY

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INTRODUCTION

The aims of this investigation have been three in number: first, to describe in some detail, certain features of the anatomy of salamanders of the genus *Pseudoeurycea* Taylor; second, to determine which anatomical features might best be used in determining the taxonomic relationships within the genus; and last, to inquire into the phylogenetic relationships of the several species studied. So far as I have been able to ascertain, the general anatomy of this group has never been recorded, nor have features other than those of the

external and skeletal anatomy been used in estimating the relationships within the group.

Pseudoeurycea, as proposed by Taylor (1944), is composed of eighteen species and subspecies, and these, on the basis of distribution and characteristics of the skeleton and external anatomy, are arranged in five species groups. These are confined to the Mexican Plateau, south from Zacatecas and Nuevo León, except that two species, *P. rex* and *P. goebeli,* occur in Guatemala.

For reasons of continuity and clarity, this paper has been divided into two parts. Part I is purely descriptive and deals with the anatomy of *P. bellii,* the most widely distributed of the species in the genus. The description of the external anatomy and buccal cavity is based upon the examination of fifteen specimens taken near Omilteme, Guerrero, Mexico; descriptions of the myology, body organs and cartilaginous parts are from dissections made of a female (Catalog Number 24274)* and a male (No. 16339) from the same locality. A cleaned and disarticulated skeleton (No. 24275) and a cleared and stained specimen (No. 16346) constituted the material from which skeletal descriptions were made.

Part II consists of brief statements of anatomical differences found in certain other species of the genus. For this phase of the work, a male and female of one species from each of the five species groups suggested by Taylor (op. cit.), were dissected and their anatomy compared to the structures considered in *P. bellii;* cleaned skeletons and cleared specimens were used for the study of the osteology. Additional material available for dissection was checked for certain differences observed in the first specimens of the species group examined; cleared specimens and skeletons were studied and external characteristics recorded where possible. The specimens used are listed below.

Gadovii group: *P. gadovii* from Veracruz (state), Mexico; ten preserved specimens (two dissected), two skeletons, one cleared specimen; *P. unguidentis* from Oaxaca (state), Mexico, two preserved specimens (one dissected), one skeleton. Smithi group: *P. smithi* from Oaxaca (state), Mexico, ten preserved specimens (two dissected), one skeleton, two cleared specimens. Cephalica group: *P. cephalica cephalica* from Puebla (state), Mexico, ten preserved specimens (two dissected), one skeleton, two cleared specimens. Leprosa group: *P. leprosa* from Puebla (state), Mexico, ten preserved specimens (two dissected), five skeletons, five cleared

* All catalog numbers refer to the EHT-HMS collection of Dr. E. H. Taylor.

specimens; *P. cochranae* from Oaxaca (state), Mexico, one preserved specimen (dissected), one cleared specimen; *P. robertsi* from Mexico (state), Mexico, one preserved specimen (dissected); *P. rex* and *P. goebeli* from near Tecpan, Guatemala, one preserved specimen each (partially dissected).

Unless otherwise indicated, the teminology of the muscles is that accepted by Francis (1934).

I am indebted to Dr. Edward H. Taylor, Professor of Zoology, University of Kansas, for guidance, criticism and suggestions concerning this work, and for the use of literature and specimens without which it could not have been undertaken. Professors E. Raymond Hall and A. Byron Leonard, University of Kansas, and Dr. Dorthea S. Franzen, Assistant Professor of Zoology, Washburn University, have given valuable assistance by criticism and suggestions during the preparation of the manuscript and the illustrations.

ANATOMY OF PSEUDOEURYCEA BELLII

External Anatomy — Female

The ground color in the female is bluish black, marked dorsally and laterally with distinct maculations which are red-orange in life, but creamy yellow in preserved specimens. The head bears one pair of maculations, usually in the parietal region immediately posterior and medial to the eye. Posterior to the nuchal groove the dorsum is marked with a series of paired spots, each pair divided by the dorsal midline and separated from the adjacent pair by an intervening costal groove. Cranially, in the region of the pectoral girdle, dorsal spots closely approximate the dorsal midline and frequently fuse across it; posterior to this area, maculations are separate and distinct.

In some specimens, indistinct and irregular spotting may occur laterally in the region of the sulcus lateralis. Rarely, for maculations are normally confined to the trunk, the first five or six segments of the tail bear marks similar to those on the trunk.

The head, broad and depressed, is only slightly longer than wide and the snout is exceptionally blunt. Maximum width of the head and maximum gape are attained at the posterior border of the eye.

The nostrils are as far apart as are the anterior extremities of the orbits, and from the ventro lateral margin of each nostril, a nasolabial groove extends ventrad to terminate at the mid-point of the subnarial swelling directly beneath. The latter is round and prominent; its center lies the width of the nostrils above the margin of the upper lip.

The greatest diameter of the eye is contained at least three times in the snout to gular fold measurement. The eyes themselves are prominent, directed forward and slightly laterad, and are situated approximately two thirds their own length posterior to the tip of the snout. A postocular groove extends caudad from the posterior angle of the eye and disappears at the juncture of the gular fold with the nuchal groove. The postocular groove is crossed by a transverse groove which lies approximately midway between the angle of the mouth and the angle of the jaw. This groove begins lateral to the dorsal midline of the head, and roughly paralleling the posterior margin of the skull, passes ventrad onto the ventral surface of the head to approach the groove of the opposite side. The postocular groove is usually less evident posterior to this point.

The gular fold is quite evident ventrally, but at the level of the angle of the jaw the fold of skin disappears. From this point the nuchal groove extends dorsad and curves slightly craniad on the dorsolateral aspect of the cervical region and terminates just short of the dorsal midline at the level of the juncture of the atlas with the first trunk vertebra.

Dorsally the skin of the head is densely pitted, and pierced by pores of small subcutaneous glands situated beneath the pits. On the upper lip and on the under side of the head, pits are reduced or absent, but the pores, slightly reduced in size, are extremely dense. Thinness of the skin on the ventral surface allows the discernment of rounded subcutaneous glands in this region. In most preserved specimens, large tan and smaller cream-colored glands can be differentiated.

Anteriorly the trunk is approximately the same width as the head, but at the level of the first two costal folds, the width is considerably reduced. Posterior to this point the trunk again broadens; the degree of this depending upon the age, sex and state of reproductive activity of the animal. From a point anterior to the pelvic region, the trunk tapers gently toward the constriction marking the junction of the trunk with the tail. This constriction is normally situated immediately posterior to the anus at the level of the posterior margin of the second caudal vertebra. The anus itself appears as a longitudinal slit in the venter immediately posterior to the pelvis. The cloacal lips are marked with a series of small folds of skin. The twelve or thirteen well-marked costal grooves are on the lateral surfaces of the body and except for a narrow strip along the midventral line, are quite visible on the ventral surface. The skin of the dorsal and dorsolateral surfaces of the trunk is densely pitted

and subcutaneous glands may be discerned through the skin. Large reddish tan glands may be differentiated from smaller, creamy yellow glands. On the venter, pitting is much reduced and glands are fewer; reduction of the number of the smaller glands is particularly noticeable. About the anus, however, subcutaneous glands are present in considerable numbers, and their pores are large.

Immediately posterior and dorsal to the base of the thigh there is an elongate oval area with pigment much reduced and with a large concentration of small light-colored subcutaneous glands. This concentration probably serves some specialized function for it is fixed in position, general structure and appearance in a series of fifteen specimens checked, and at no other point of the body is an equally dense concentration of glands visible. Though this area is mentioned in the literature, no name has been found designating it; it is suggested therefore, that it be termed the *post-iliac gland.*

Extending caudad and dorsad from the dorsal extremity of the gular fold, a ridge marking the position of the m. subarcualis rectus I (and the epibranchial cartilage which it surrounds), passes dorsal to the insertion of the forelimb and terminates at the anterior part of the third costal fold.

Both forelimbs and hindlimbs are stout and long enough to be well adapted to walking; one to four costal folds separate the digits of the adpressed limbs. The hand is broad and depressed, the palmar aspect presenting a roughly rounded outline. The four digits, in order of length 3-2-4-1, show no webbing of the two distal phalanges in the second, third and fourth digits, and the distal phalanx of the reduced first digit is also free. Each of the digits carries a prominent, ventrally-projecting lobe or pad of tissue which covers the ventral surface of the distal phalanx. Five digits are present on the foot, in order of length 3-4-2-5-1. These tend to be more widely spread than the digits of the hand but the distal phalanges carry pads similar to those mentioned above. The reduced first and fifth digits have but one phalanx free, whereas the other three have two or two and one-half unwebbed phalanges.

The tail is long and powerful, constricted at the base, and roughly round in cross-section. In large specimens the anterior part of the tail is greater in diameter than the terminal part of the trunk, but in smaller specimens, the greatest diameter may occur near the third or fourth caudal fold. The tail is deeply marked laterally by caudal grooves, which become slightly less evident toward its posterior extremity. From its greatest diameter near its anterior limit, the tail is tapered smoothly to its tip.

EXTERNAL ANATOMY—MALE

In males, coloration and markings are similar to those in the female, but there is a more marked lightening of the ground color on the lateral and ventral surface in most specimens. The nostrils are slightly more elongate transversely, tapering toward their lateral margins, and the nasolabial groove divides into several faint furrows at the ventral or antero-ventral limit of the mildly pendent subnarial swelling. The latter attains its maximum prominence immediately ventral to the margin of the upper lip.

A submental gland almost round in outline, and smooth and flattened on its ventral surface is situated behind the anterior extremity of the lower jaw. The antero-posterior diameter of the gland is approximately one sixth the distance from the snout to the gular fold. Removal of the gland reveals that it is dorsally rounded and fits, posterior to the mandibular symphysis, in the curve of the lower jaw. Since neither ducts nor openings of such structures could be found associated with the submental gland it has been tentatively concluded that the glandular product must be exuded through the minute pores distributed densely in the skin covering the gland.

Except that the cloacal lips are papillate and the dorsal maculations near the posterior limit of the trunk are the site of heavy concentrations of subcutaneous glands, no other differences in the external appearance of the two sexes were noted.

BUCCAL CAVITY

The mucous membrane of the floor of the mouth is marked by rugose longitudinal folds which are continuous anterior to the tongue. Posterior to the mandibular symphysis and immediately anterior to a depressed area where the membrane is smooth, these folds are accentuated to form a distinct curved sublingual fold. Posterior to this, the stalk of the boletoid tongue projects into the buccal cavity through the center of the depressed area, and is affixed to the body of the tongue anterior to its midpoint, in the curve of a ventrally-projecting U-shaped ridge of tissue. The latter fits well into the depression in the floor of the mouth when the tongue is fully retracted. The dorsal surface of the tongue is densely covered with large papillae arranged roughly in rows radiating from the center of the surface.

The mandible carries from 34 to 44 (average 40) short teeth fused to the medial side of the dentary. The tip of each tooth curves sharply inward, and each tooth carries a subterminal point on its

anterior surface, just proximal to the terminal tip. The extremities of both the terminal and subterminal points are marked with reddish brown. Anterior teeth are approximately vertical or slant but slightly inward but immediately anterior to the articulation of the mandible, the teeth are slanted almost horizontally into the buccal cavity.

The palatine surface of the mouth is covered with heavy mucous membrane and is bounded anteriorly and laterally by the upper lip and the teeth of the premaxilla and maxillae. The premaxillary dentition shows marked sexual dimorphism; in adult males there are but four teeth on the premaxilla, while in females, thirteen teeth are usually present. The premaxillary teeth in males are greatly elongated, penetrate the upper lip and no subterminal point is visible on them. Premaxillary dentition of this sort is evidently not present on young individuals, for in two immature males, premaxillary teeth were similar in number and structure to those of females. The premaxillary teeth in females closely resemble those of the mandible, and form a row aligned with the rows of maxillary teeth but separated from the latter by a short diastema. Maxillary teeth varied in number from thirty-four to fifty in the specimens examined, the larger numbers present in older specimens. The females showed the widest range of variation in the number of teeth present on the maxilla and limited data tend to indicate that teeth may be added on this element with increase in size and age. From thirty-five to forty maxillary teeth were present in the males examined. The internal nares are situated approximately twice their own antero-posterior diameter postero-lateral to the premaxilla, and approximately half that distance anterior to the rows of prevomerine teeth. The openings of the internal nares are oval, but each opening is extended by a cleft at its lateral margin. This cleft, which I term the *latichoanal fissure,* follows the outline of the slit in the prevomer, extends to the lateral extremity of the prevomerine tooth row, then is continued caudad by a groove in the mucous membrane. This groove is medial to the base of the fold of mucous membrane, bordering the maxillary teeth. At the posterior limit of the maxilla, the groove turns caudo-mediad and disappears almost immediately.

The lateral extremities of the rows of prevomerine teeth are separated from the midpoints of the maxillae by approximately the diameter of the internal naris, and from each other medially, by approximately half that distance. Laterally the prevomerine teeth are in a transverse row, but medial to the internal nares, the rows

curve caudally as they approach the midline. From eighteen to twenty-one teeth were present in prevomerine rows in the specimens examined.

Two patches of paravomerine * teeth lie approximately twice the diameter of the internal naris posterior to the medial extremities of the prevomerine rows. The patches are separated medially by a narrow grove, are wider posteriorly than anteriorly, and extend to the level of the angle of the jaw. The teeth of these patches are arranged in oblique rows resembling caudally-directed chevrons, but no constancy could be found in either the number of rows or the number of teeth. Paravomerine and prevomerine teeth are similar to the teeth of the mandible.

VISCERA

Though the viscera probably merit detailed study, seasonal variations in the reproductive organs, and daily variation in the alimentary canal, make comparisons impractical unless large series of specimens are available. I am, however, calling attention to a few of the structures noted in the specimens examined.

The stomach is large and extends caudad for fully three fourths the total length of the coelom. The duodenum extends craniad along the right wall of the stomach and comes to lie dorsally and to attach to the liver near its posterior margin. The ileum and colon are of approximately equal length and each is slightly longer than the duodenum. The ventral mesentery is but slightly reduced and is present along the full length of the coelom. Extending along the midventral line, the mesentery attaches anteriorly to the ventral surface of the liver and clearly shows continuity with the gastrohepatic and hepatoduodenal ligaments at the posterior margin of that organ. The dorsal edge of the mesentery is not attached for a distance equal to the width of one costal fold posterior to the liver, but at that point it envelops the urinary bladder and attaches to the ventral surface of the colon throughout its length.

The structures of the urogenital systems of male and female are delicate and difficult to dissect; consequently a histological study of serial transverse sections probably will have to be made to determine all the relationships. In both sexes the mesonephroi appear to be loosely organized structures composed of tiny, coiled tubules. In females, the mesonephroi are broad, lateral to the cloaca, and taper slowly toward their anterior extremities just craniad to the

* This name was first proposed by Dr. Hobart M. Smith and was published by Dr. Edward H. Taylor (1944:206).

anterior limits of the ovaries. In males, the mesonephroi are well defined only at the posterior limit of the coelom; anteriorly, slender extensions of the organs are attached to the medial surface of the male duct.

In females, there is a slender straight oviduct extending retroperitoneally to the cloaca, from a well-defined ostium attached to the transverse septum and ventral mesentery. Lateral to the anterior part of the mesonephros, a tiny duct (probably the mesonephric duct), is separable from the medial surface of the oviduct, but in the region of the broader posterior part of the mesonephros, that duct cannot be discerned. In the latter region, well-defined urinary tubules leave the mesonephros and appear to enter directly into the oviduct; however, the mesonephric duct may be present, fused to the oviduct. In males, somewhat caudal to the position of the ostium in the female, a tiny opening with slightly flared lips communicates with a delicate, straight, retroperitoneal duct. Immediately cranial to the anterior limit of the testis, this duct is continuous with a large convoluted duct suspended by a distinct mesentery. With the anterior extension of the mesonephros attached to its medial wall, this duct extends caudad, receives the efferent ductules from the anterior lobe of the testis, and from the mesonephros, receives several urinary tubules before entering the cloaca.

Anteriorly there is marked similarity in the internal organization of the cloacae of the male and female. In both sexes the lining is thrown into deep longitudinal folds, the urogenital ducts open into the dorsolateral walls, and the urinary bladder opens into the ventral wall of the cloaca. Near the cloacal lips however, the lining of the cloaca becomes papillate in the male, while in the female, the folds are reduced but otherwise unchanged.

Three pairs of tubular glands empty into the cloacae of males. The ventral cloacal glands are gray in color and are divided into two parts by the mm. ischio-caudalis. The abdominal glands are rust-red. They are composed of longer tubules than are the cloacal glands, and are situated antero-dorsal to the cloaca. The pelvic glands, short and creamy white, are situated posterior and dorsal to the cloaca. All open directly through the cloacal wall.

Skull

The skull is broad and depressed, is approximately as wide as it is long, and its greatest depth (measured from the ventral surface of the parasphenoid to the dorsal surface of the parietal), is contained approximately three and one-half times in its maximum

length. With the bones of the lower jaw in their normal position, the skull appears roughly ovoid from above. The fused premaxillae, the maxillae and the mandibles form the margins curving to the point of greatest width at the posterior limits of the quadrates. The otic-occipital region extends cauded and narrows slightly to form the broader posterior curvature of the skull. Viewed laterally the skull is bluntly wedge-shaped, its depth increasing from its anterior to its posterior limits.

The skull is composed of the parasphenoid, the fused premaxillae, and paired nasal, maxillary, prevomer, prefrontal, frontal, parietal, otic-occipital, squamosal, quadrate, and orbito-sphenoid bones, and the pterygoid cartilages. These elements are considered in the following paragraphs.

The premaxillae are fused into a single bone and a pair of frontal processes arise from a medially thickened elevation on its dorsal surface. The frontal processes are thin, parallel and moderately spatulate toward their posterior extremities. They enclose between them a well-defined fronto-premaxillary fontanelle which extends cauded to the level of the anterior margin of the orbit. Laterally the premaxilla is united to the maxilla by cartilaginous connective tissue, while the maxilla articulates with the prefrontal and nasal by means of a roughly rectangular frontal process, notched anteriorly at its base. The external nares are situated at the level of this notch and are approximately midway between the frontal processes of the premaxilla and maxilla; no septo-maxillary element is present. Posteriorly, the frontal process of the maxilla forms the ventral half of the anterior margin of the orbit, and dorsally articulates with the poorly-ossified prefrontal and nasal. The former is affixed to the posterior fourth of the frontal process and forms the dorsal half of the anterior margin of the orbit, while the latter is affixed to the anterior half of the frontal process, roofs the nasal capsule and forms the dorsal margin of the external nares. Both the prefrontal and nasal articulate with the frontal and frontal process of the premaxilla.

The frontal, roughly leaf-shaped anteriorly, narrows to form the anterior half of the dorsal margin of the orbit, and overlaps the parietal posteriorly. The fronto-parietal articulation is accomplished by means of a dentate process on the posterior margin of the frontal. The two frontals are strongly articulated by irregular dovetailing processes carried on the medial margin of each.

The parietal is bluntly pointed at its lateral margin anteriorly. It shows medially, even more distinctly than the frontal, irregular articulating processes, and is depressed postero-medially and is

flared postero-laterally for articulation with the dorsal surface of the otic-occipital. Approximately at its midpoint, the parietal carries a ventral projection on its lateral margin. This projection lies medial to (and serves to strengthen), the dorsal cartilaginous articulation of the orbito-sphenoid with the otic-occipital.

The otic-occipital is covered antero-medially by the parietal, and the postero-lateral part of its dorsal surface is depressed, and slightly ridged by the vertical semicircular canals. The postero-lateral part of the dorsal surface of the otic-occipital is rounded and furnishes articulation for the proximal half of the squamosal. Dorso-medially each otic-occipital presents a well-ossified process; these two processes are united at the midline by a cartilaginous remnant of the synotic tectum.

Antero-laterally, beneath the midpoint of the lateral margin of the parietal, the otic-occipital carries an oval process, which articulates with cartilage extending from the dorsal posterior process of the orbitosphenoid. The bone, rectangular and well-ossified, forms the lateral wall of the cranial cavity and articulates anteriorly with the nasal capsule by dorsal and ventral processes. The ventral posterior articulation of the orbito-sphenoid is accomplished by means of a short cartilage which joins with a process extending anteriorly from the base of the otic-occipital. Both of the posterior articulating processes of the orbito-sphenoid are short and have only a narrow groove between them. The base of this groove is formed by narrow processes extending from each articulation and fusing posterior to the large optic foramen.

Immediately lateral to the posterior ventral articulation of the orbito-sphenoid, the same projection of the otic-occipital articulates with the postero-medial surface of the pterygoid cartilage. This rectangular element is thick and solid at the point of its articulation with the otic-occipital, but laterally it thins, is more flexible, and is attached to the antero-medial surface of the quadrate. Anteriorly, the pterygoid cartilage is markedly thinner. It forms the postero-ventral margin of the orbit and attaches to the postero-medial aspect of the maxilla.

The quadrate is short, heavy and well ossified. Viewed laterally it appears to be rectangular, but examination of its internal surface reveals that the major part of the bone is in the form of an irregular cylinder constricted at its midpoint. The rectangular appearance is imparted by a thin bony flange on its antero-lateral margin. The quadrate articulates proximally with a lateral projection of the otic-occipital, and distally with the lower jaw.

The squamosal is thin and shaped to conform with irregularities of the elements to which it is attached. The proximal half of the squamosal is narrow and closely applied to the dorsolateral surface of the otic-occipital, posterior to the ridge of the semicircular canal. The distal half of the squamosal widens and is attached to the proximal half of the lateral surface of the quadrate.

In its postero-lateral wall, just posterior to its articulation with the quadrate, the otic-occipital has a large round opening, the fenestra vestibulae. This opening is covered by a tough membrane to which is fused the bony operculum. No columella auris is carried on the operculum.

The crista muscularis is immediately postero-dorsal to the fenestra vestibulae and this roughened ridge marks the position of the horizontal semicircular canal. Ventral to each crista muscularis and ventro-lateral to the margin of the foramen magnum, there is a short sessile occipital condyle. Antero-medial to these, the otic-occipitals are united in the median plane by processes ossified in the region of the embryonic hypochordal commissure.

The broad, rounded, posterior part of the parasphenoid is attached to the ventral surface of the otic-occipitals, anterior to the occipital condyles and medial to the process articulating with the orbito-sphenoid. Anterior to this attachment, the parasphenoid tapers toward its spatulate attachment to the ventral surface of the nasal capsules. The parasphenoid is attached to the ventral margins of the orbito-sphenoids throughout its length, and loosely attached to its ventral surface are the two paravomers, discontinuous processes of the prevomers.

The postero-medial extremity of the prevomer is firmly fused to the ventral surface of the anterior part of the parasphenoid. From this area the dental process of the prevomer curves laterally, forming the posterior margin of the opening for the internal naris and the latichoanal fissure. The prevomer extends craniad from its articulation with the parasphenoid and forms the medial margin of the narial opening, then curves ventrad and widens abruptly to form an antero-lateral wing. The latter attaches loosely to the premaxilla and maxilla, and forms the anterior margin of the opening for the internal naris and the latichoanal fissure. Medially the prevomer articulates with that of the opposite side by means of a thin cartilage.

The dentary is approximately round in cross section in its anterior third, but posterior to that part, its medial surface is deeply grooved to receive Meckel's cartilage. Except at its anterior and posterior

extremities, this cartilage is completely enclosed between the dentary and angulare. At its posterior extremity the cartilage articulates with the quadrate.

The angulare is pointed anteriorly to fit the groove in the medial surface of the dentary, and is solidly attached to the dorsal and ventral margins of that groove. The angulare forms a coronoid process on the dorso-medial margin of the posterior fourth of the mandible, and its ventral margin extends laterally to invest the ventral surface of the posterior part of Meckel's cartilage.

Hyobranchial Apparatus

In a general way the hyobranchial apparatus corresponds with the description given by Smith (1920:536), for that of *Eurycea bislineata*. The cartilaginous elements differ somewhat in their configuration however, and neither a lingual cartilage nor an os thyroideum is present.

The thin, free, dorsally-curved, anterior extremities of the ceratohyals extend into the sublingual fold and lend weak support to that structure. Posteriorly the flattened parts of the cartilages form the lateral margins of the opening for the stalk of the tongue, then broaden posterior to that opening to form its postero-lateral margins and offer broad surfaces for the attachment of the m. suprapeduncularis. Caudal to the attachments of that muscle, the ceratohyals become rounded and extend caudo-laterad deep to the two superficial layers of hyobranchial muscles. Just posterior to the level of the angles of the jaws, the ceratohyals curve sharply dorsad and craniad; their distal extremities come to lie immediately posterior to the fused quadrates and squamosals, and are attached to the mid-points of the posterior surfaces of those bones by short stout hyoquadrate ligaments.

The broad anterior extremity of the basibranchial bears small antero-lateral horns and is situated and firmly attached within the body of the tongue. Posteriorly the basibranchial is rodlike and extends caudo-ventrad for half its own length, within the stalk of the tongue. At the base of that structure the basibranchial receives the proximal articulations of the first ceratobranchials on its ventral surface, then extends caudad to articulate with the second ceratobranchials at its posterior extremity.

The first ceratobranchials are S-shaped and approximately as long as the basibranchial. They are flattened at their proximal articulations, but posteriorly they twist mediad about their own axes and become medially concave. The distal third of each is closely ap-

plied and attached to the lateral surface of the distal half of the second ceratobranchial. The latter is heavy, shorter than the basibranchial, and each of the pair extends caudo-laterad to attach, in company with the first ceratobranchial, to the proximal extremity of an epibranchial.

The eipbranchials are flexible, slender and approximately three times as long as the basibranchial. They lie entirely within the sheaths formed by the mm. subarcualis rectus I, and are tapered toward their distal extremities.

VERTEBRAE

The vertebral column consists of one cervical vertebra, fourteen trunk vertebrae, one sacral vertebra and a variable number of vertebrae posterior to the sacrum. These elements are joined by a modification of the amphicoelous type of intervertebral articulation; the centra are biconcave but show calcification of the cartilage contained within their cavities. The amount of cartilage calcified is variable, and according to Taylor (1944:204), is correlated with the age of the specimen. In none of the vertebrae examined was the calcification complete to the lip of the centrum, but in every case the concavity of the centrum was partly filled with soft partially calcified cartilage.

The cervical vertebra differs markedly from others in the series, for the centrum is present only posteriorly. The ventral surface of the centrum bears a pair of longitudinal bony ridges, which extend to the posterior limit of the paired lateral projections furnishing articulation with the occipital condyles. The anterior faces of these projections are slightly concave, and from between them, a broad odontoid process extends craniad to fit into the foramen magnum and articulate with the walls of that opening. The facets of the odontoid process are convex and situated on its ventro-lateral surfaces. A heavy neural arch is present dorsally and that structure bears a pair of well-developed postzygapophyses on its posterior margin and a low, rounded, cartilaginous neural spine dorsally. The trunk vertebrae are not notably modified one from another; the eighth vertebra is here described as typical. The centrum is long, slender and biconcave, and its dorsal neural arch is low and broad. The neural spine is long and low and is formed by a thin plate of bone affixed vertically to the mid-dorsal line of the neural arch. The zygapophyses are broad and flat; the articulating surfaces of the prezygapophyses are directed dorso-medially, and those of the postzygapophyses are directed ventro-laterally. Medial to

the postzygapophyses the neural arch carries two small triangular projections on its posterior margin. The neural canal is rounded dorsally, flattened ventrally and is completely roofed by the neural arch. Paired diapophyses and parapophyses extend caudad and slightly laterad from each trunk vertebra except the last. These processes are fused except at their bases and at their distal extremities where they diverge slightly to articulate with the ribs. The last trunk vertebra bears only parapophyses; the diapophyses are considerably reduced.

The ribs are bicipital, and those of the first two or three trunk vertebrae may be slightly forked at their distal extremities. Posterior to that, ribs are not modified distally. The last pair of ribs is reduced to simple cartilaginous stubs carried on the parapophyses of the last trunk vertebra.

The sacrum is similar to the trunk vertebrae in most respects, but the parapophyses and diapophyses are markedly heavier, are not as closely approximated as those of the trunk vertebrae and are considerably expanded at their lateral extremities. The sacral rib is heavy, deeply forked proximally, and expanded distally for articulation with the ilium.

Posterior to the sacrum, the vertebrae differ markedly from those discussed above. The first two vertebrae of this series are transitional, and show the abrupt loss of characteristics typical of the trunk vertebrae, and the concurrent addition of structures peculiar to typical caudal vertebrae. Since these two vertebrae are unlike each other, differ from other vertebrae of the body, and are in a region considered to be a part of the trunk, it is suggested that they be designated *precaudal vertebrae.*

The first precaudal vertebra has the parapophyses and diapophyses considerably reduced and fused. The neural arch is low and no haemal arch or spine is present. The second precaudal vertebra has no parapophyses or diapophyses which are recognizable as such, but bears a winglike lateral projection near the base of each prezygapophysis. An incomplete haemal arch is present on the ventral surface of the centrum, and from this a strong, deeply bifurcate haemal spine projects caudad and ventrad to lie ventral to the anterior part of the centrum of the first caudal vertebra. The haemal spine of the second precaudal vertebra is notably longer, heavier and directed more caudally than the haemal spines of the caudal vertebrae. The pair of projections medial to the postzygapophyses are broad and project dorsally.

In general shape and structural relationships the caudal vertebrae

are quite similar one to another, but because of progressive reduction toward the tip of the tail, the second caudal vertebra is here described. The neural arch, centrum and zygapophyses bear the same general relations as described for the trunk vertebrae, but the neural spine is low and the pair of projections medial to the postzygapophyses are enlarged and extend dorso-caudally. From the ventro-lateral surface of the prezygapophyses, a dentoid spine projects laterally, its distal half extending past the lateral limit of the prezygapophysis. Attached to the ventral surface of the centrum in its posterior two thirds is a heavy haemal arch from which a bifurcate haemal spine projects caudo-ventrally past the level of the posterior limit of the centrum. Attached to the ventral surface of the haemal arch and to the antero-ventral surface of the haemal spine, is a thin ventrally-projecting lamella of bone. This lamella is rather large and projects anteriorly past the anterior margin of the haemal arch.

THE SKELETON OF THE GIRDLES AND LIMBS

In general structure and configuration, the skeletal elements of the pectoral and pelvic girdles and their appendages have typical salamandroid form. For that reason, they are only partially described here.

The sternal cartilage is delicate, has approximately the shape of an equilateral triangle and though attached to the coracoid cartilages by fasciae, is not otherwise articulated with them. The scapulo-coracoids are well-ossified but appended cartilages are broad and thin. The glenoid fossa is deep and bony.

The elements of the forelimbs are stout and articulated with heavy cartilages. The phalangeal count is 1.2.3.2; the proximal phalanges are hourglass-shaped, and the distal phalanges are terminally broadened to assume the shape of a broad-based "T".

The roughly rectangular puboischiac plate is heavy and formed mostly of two well-ossified ischia joined in the median plane by a cartilaginous symphysis. The cranial margins of the ischia are fused with narrow but heavy pubic cartilages, which form the anterior fourth of the plate. The ilium, short, heavy and largely ossified, articulates with the puboischiac plate by way of heavy cartilage. Dorsally the ilium bears a heavy, round, platelike iliac cartilage, and to the internal surface of this element, the sacral rib is attached by a cartilaginous enlargement of its distal extremity. The acetabulum is deep; its medial and medio-dorsal wall is formed by the ventral part of the ilium, its postero-ventral wall by the lateral cartilaginous part of the ischium, and its antero-ventral wall

by the pubic cartilage. The anterior and posterior walls of the acetabulum are formed by thin cartilages extending from the ilium to the pubic cartilage and to the ischium.

The elements of the hindlimb are stout and firmly articulated. Structure of the bones is typically salamandroid, the phlangeal count is 1.2.3.3.2, and the phlanges have the same shape as described in the hand.

Hyobranchial Musculature

superficial layer

M. Intermandibularis Anterior: This muscle, considered to be a modification of the larval muscle of the same name, is the most anterior of the superficial muscles in this region. It is situated anterior to the cranial extremity of the median raphe, and attaching laterally to the fasciae of the anterior parts of the two intermandibularis posterior muscles, it extends across the ventral midline without interruption of its fibers. It is thin, narrow and short and although it is easily distinguished from the m. intermandibularis posterior, the m. intermandibularis anterior is difficult to separate along its posterior margin because of its close attachment to the posterior muscle.

M. Intermandibularis Posterior: This muscle is composed of two distinct parts. The more anterior of these originates from the dorso-medial aspect of the mandible, just posterior and lateral to the origin of the m. geniohyoideus lateralis and from the fascia of that muscle. This part extends from its origin to insert on the antero-lateral margin of the median raphe. The posterior part of the m. intermandibularis posterior, a sheetlike muscle (as is the anterior part), originates along a line on the dorso-medial surface of the mandible. This line of origin begins at a point one half the width of the posterior part of the muscle caudal to the anterior part, and extends to a point just anterior to the caudal limit of the mandible. From its origin the posterior part of the m. intermandibularis posterior extends mediad, fanning slightly before it inserts on the lateral margin of the median raphe.

M. Quadrato-pectoralis—Drüner (1901): The m. quadrato-pectoralis is the most caudad of the superficial muscles in this region. It originates, as a narrow heavy band, ventral to the attachment of the hyoquadrate ligament, from the postero-medial surface of the ventral half of the quadrate, then fans out as it extends craniad and mediad. The anterior half of the muscle passes dorsal to the posterior part of the m. intermandibularis posterior and inserts

by a common aponeurosis with the posterior fourth of that muscle. The posterior half of the m. quadrato-pectoralis inserts chiefly along the lateral margin of the median raphe, but a few fibers near the posterior border of the muscle turn caudad to insert on the pectoral fascia, and at least one tiny slip attaches to the gular fold in common with the medial margin of the m. gularis.

M. INTERHYOIDEUS: This muscle, deep to the m. intermandibularis posterior and the m. quadrato-pectoralis, originates from the anterior surface of the lateral extremity of the ceratohyal. From its origin the m. interhyoideus extends craniad and mediad, fanning and thinning. It inserts dorsally on the aponeurosis of the posterior part of the m. intermandibularis posterior; the insertion extends one fourth the width of the aponeurosis anterior and posterior to the midpoint of that structure. The m. interhyoideus twists 180 degrees in passing from its origin to its insertion; the fibers originating most cranially insert caudally on the aponeurosis.

M. GULARIS—Smith (1920): The m. gularis originates from the fascia cephalo-dorsalis on the dorsolateral aspect of the head. Its line of origin coincides with the line traced by the postocular groove, and extends from the angle of the mouth, to the ventral limit of the nuchal groove. From its origin the m. gularis curves obliquely caudad to insert on the skin of the gular fold from just lateral to the mid-ventral line to a point near the dorsal extremity of the fold.

SECOND LAYER

M. GENIOHYOIDEUS MEDIALIS—Smith (1920): This muscle originates from the ventral surface of the dentary just lateral to the mandibular symphysis. The muscle extends caudad from that point showing little change in its form throughout its first half, but posterior to that, it spreads and becomes thinner (particularly toward the midline). The insertion is made by means of fleshy slips, chiefly on the myocommata at the superficial anterior boundary of the m. rectus cervicis. The thin medial part of the m. geniohyoideus medialis slightly overlaps the midline and the same part of the m. geniohyoideus medialis of the opposite side; these medial parts of the two muscles insert by a thin common aponeurosis. The lateral fourth of the muscle inserts by fleshy slips on the fascia of the m. subarcualis rectus I.

M. GENIOHYOIDEUS LATERALIS—Smith (1920): This muscle originates from the ventral aspect of the dentary lateral to the mandibular symphysis and posterior to the origin of the m. geniohyoideus medialis. The origins of the muscle last named and of the m.

geniohyoideus lateralis are so close together that, upon first impression, the two muscles seem to have a common origin. Laterally the origin of the m. geniohyoideus lateralis extends along the postero-ventral margin of the dentary to a point slightly anterior and medial to the origin of the anterior part of the m. intermandibularis posterior.

The m. geniohyoideus lateralis extends caudad from its origin, fanning slightly laterally. The medial part of the muscle lies dorsal to the m. geniohyoideus medialis and passes dorsal to the ceratohyal to insert on the fascia of the floor of the mouth; the lateral part of the m. geniohyoideus lateralis inserts by fleshy slips on the antero-ventral margin of the ceratohyal, lateral to its midpoint.

M. Rectus Cervicis: This muscle is a direct continuation of the m. rectus abdominis; its origin has been described above. From its origin, the m. rectus cervicis extends craniad as a broad sheet covering the ventral surface of the throat. Immediately posterior to the first spiral of the m. abdominohyoideus, the m. rectus cervicis sends a rounded slip dorso-cranially to insert on the mucous membrane of the floor of the mouth, dorsal to the basibranchial. The major part of the m. rectus cervicis crosses the proximal tip of the epibranchial and the ceratobranchial, then turns dorsad to insert by fleshy slips on the postero-ventral surface of the ceratohyal from just caudal to its anterior tip to a point at the level of the posterior limit of the basibranchial. In this course, the m. rectus cervicis crosses five myocommata, the anterior two of which are well marked.

A part of the m. rectus cervicis, probably comparable to the *m. rectus cervicis superficialis* described by Francis (1934:68), originates from the dorsal surface of the sternal cartilage near its antero-lateral margin. From that point the slip passes obliquely laterad and craniad, ventral to the main mass of the m. rectus cervicis, until at the third myocomma crossing the muscle, the fibers of the two become inseparably intermingled.

DEEPER MUSCLES

M. Subarcualis Rectus I: This muscle originates by a series of discrete slips from the postero-ventral margin of the ceratohyal, just medial to its lateral extremity. The most medial of these slips is immediately lateral to the lateral border of the m. rectus cervicis. Fibers of the muscle pass caudad from the origin forming a distinct band on the dorsal surface of the main mass of the muscle and extending for approximately two thirds its total length. From the base of the epibranchial cartilage however, fibers depart from the

longitudinal band and "with new fibers formed at metamorphosis" (Smith, 1920:541), form a complicated spiral around the epibranchial. This arrangement results in the formation of a muscular sac which extends just posterior to the posterior extremity of the epibranchial. Contraction of the muscle forces the cartilage from the sheath, much as water is forced from a rubber bulb, for there is no insertion of muscle fibers on the cartilage.

M. ABDOMINOHYOIDEUS—Smith (1920): This muscle originates from the entire ventral surface of the ischium, deep to the m. puboischio-femoralis externus. From its spatulate origin, the m. abdominohyoideus passes craniad leaving the pubo-ischiac plate between the medial and lateral origins of the m. rectus abdominis, and enters a sheathlike passage between the mm. obliquus externus (deep portion) and transversus abdominis. Within this sheath the m. abdominohyoideus continues craniad just lateral to the m. rectus abdominis, and at the level of the second costal fold, splits into two easily separable slips. These continue in close association as the m. abdominohyoideus passes deep to the pectoral girdle, but at the level of the anterior myocomma of the m. rectus cervicis, the smaller, flat, dorsal slip curves, comes to lie ventral to the main mass of the muscle, and the two parts diverge. The small flattened slip passes deep to the m. rectus cervicis and inserts on the ceratohyal in common with that muscle. The main bundle of the m. abdominohyoideus, round in cross-section, turns mediad, and immediately posterior to the basibranchial is thrown into a spiral. The muscle makes one and three-fourths turns in the spiral, crosses the proximal half of the second ceratobranchial ventrally, curves dorso-medially across the proximal third of the first ceratobranchial dorsally, then comes to lie dorsolateral and parallel to the basibranchial. In this relation to the cartilage, this part of the m. abdominohyoideus extends within the stalk of the tongue to insert on the anterior tip of the basibranchial and on connective tissue within the tongue itself.

M. HYOGLOSSUS: This muscle arises from the anterior tip of the basibranchial cartilage. It is minute and poorly defined, and (so far as could be demonstrated by the dissection methods employed) radiates from its origin and inserts on connective tissue in the tongue.

M. SUPRAPEDUNCULARIS—Smith (1920): This muscle is a thin flat band of fibers extending between the cranial portions of the two ceratohyals, immediately posterior to the stalk of the tongue. The muscle is firmly affixed to the dorsal surface of each ceratohyal near its antero-lateral margin, and the anterior margin of the muscle

serves to bound the posterior lip of the opening through which the stalk of the tongue protrudes.

Musculature of the Mandible

M. Depressor Mandibulae: This muscle corresponds in a general way with the same muscle in other salamanders, but in this group it is specialized to the extent of having three distinct heads. Two of these have their origins separated widely enough to bring about a considerable difference in the angle through which the muscles act upon the mandible, and the two muscles can be separated with ease from their origins to their insertions. Furthermore, each muscle is innervated by a separate twig from the seventh cranial nerve. Consequently, the m. depressor mandibulae here is divided into two parts as follows:

M. Depressor Mandibulae Posterior (new name): This triangular, sheetlike muscle lies deep to the m. gularis, and originates from the fascia cephalo-dorsalis along a line immediately dorsal to the ventral margin of the m. longissimus capitis of Nishi (Francis, 1934:93). The fibers are firmly attached to the skin at the nuchal groove, which is the posterior limit of the origin. The anterior limit of the origin is immediately posterior to the level of the angle of the jaw.

The fibers of the m. depressor mandibulae posterior converge as they extend cranio-ventrad and insert on the angulare, at the postero-ventral angle of the mandible, by means of a short tendon. The anterior margin of the muscle is proximate to the posterior margin of the m. depressor mandibulae anterior throughout the greater part of its length, but the two are not fused and are quite separable.

M. Depressor Mandibulae Anterior (new name): This muscle is composed of superficial and deep heads that are clearly separable throughout, although supplied by the same twig of the seventh cranial nerve. The superficial head, large, heavy and flattened, lies just posterior to the m. levator mandibulae externus and just ventral to the m. longissimus capitis. The origin of this superficial head is from the common aponeurosis of the mm. longissimus capitis and levator mandibulae externus, from the fascia of the latter muscle, and from the otic-occipital along the ridge of the anterior vertical semicircular canal. A few fibers on the internal surface of the muscle may originate from the lateral surface of the squamosal.

Extending ventrad and slightly caudad, the fibers of the superficial head of the m. depressor mandibulae anterior diverge slightly

toward the midpoint of the muscle, then converge markedly in passing to insert by a fleshy slip on the postero-lateral margin of the dentary, and on the exposed posterior surface of Meckel's cartilage immediately dorsal to the insertion of the m. depressor mandibulae posterior.

The deep head of the m. depressor mandibulae anterior originates from the lateral and postero-lateral surfaces of the quadrate. Converging from a thin sheet to form a rounded bundle, the fibers of the deep head curve ventro-medially around the postero-lateral surface of the quadrate and insert on the posterior surface of Meckel's cartilage and the posterior margin of the angulare. The insertion is fleshy, medial to the insertion of the superficial head and is dorsal to the insertion of the m. depressor mandibulae posterior.

M. LEVATOR MANDIBULAE EXTERNUS: The dorsal third of this heavy, roughly rectangular sheet of muscle originates from the fascia of the superficial portion of the m. levator mandibulae anterior, along a line crossing transverse to the axis of that muscle at its curvature. The middle third of the m. levator mandibulae externus arises from a common aponeurosis with the anterior margin of the m. longissimus capitis, and the ventral third of the muscle arises from the antero-lateral surface of the squamosal. The m. levator mandibulae externus curves ventrad, its anterior margin bordering the postero-ventral margin of the eye, and inserts on the mandible. The anterior fibers of the muscles are closely attached to the skin at the angle of the mouth, but insert on the lateral margin of the dentary by means of a broad tendon. Posteriorly the insertion of the m. levator mandibulae externus is fleshy and is attached to the latero-dorsal margin of the dentary. Some of the deeper fibers insert in common with or proximate to the mm. levator mandibulae anterior (superficial portion) and levator mandibulae posterior.

M. LEVATOR MANDIBULAE POSTERIOR: This muscle is short, heavy, broad and somewhat triangular in outline. It lies deep to the m. levator mandibulae externus and originates from the anterior and antero-medial surfaces of the quadrate. With its antero-dorsal margin overlapping the posterior margin of the m. levator mandibulae anterior (superficial portion), the m. levator mandibulae posterior extends cranio-ventrad to insert, the more anterior fibers in common with the m. levator mandibulae anterior (superficial portion), and the posterior fibers on Meckel's cartilage anterior to the articulation with the quadrate and on the dorsal margin of the coronoid process.

M. Levator Mandibulae Anterior (superficial portion): This muscle, a heavy, cordlike bundle of fibers, originates from a short heavy tendon attached to the neural spine of the atlas. From its origin the muscle extends craniad, becoming heavier as it passes dorsal to the medial border of the otic region, then curves ventrad to pass caudad to the orbit. The muscle passes almost directly ventrad from this curvature, and inserts by means of a short aponeurosis on the dorsal margin of the angulare anterior to its posterior limit.

M. Levator Mandibulae Anterior (deep portion): This muscle is short and heavy. It has a broad origin from the dorsolateral surfaces of the frontal and parietal at the postero-dorsal margin of the orbit, but the fibers converge abruptly as they pass ventrad. The fibers terminate on a long triangular tendon, which passes ventrad, deep to the m. levator mandibulae anterior (superficial portion), and the articulation of the mandible with the quadrate, and inserts on the medio-ventral surface of the angulare directly ventral to the articulation.

Musculature of the Body Wall

In *Pseudoeurycea* as in all salamanders, the muscles of the body showing little specialization preserve the myotomic arrangement shown in the embryo. The muscles described below are either composed of a series of myotomes fused to act as a united whole, or still show their myotomic arrangement by the presence of reduced myosepta, here called myocommata.

M. Obliquus Externus (superficial portion): This muscle, the most superficial layer of the muscles of the body wall, originates by tendinous slips from the fascia cephalo-dorsalis and the skin. The muscle extends from the level of the base of the forelimb to the tenth costal fold. Its fibers pass almost transversely ventrad (except at the posterior extremity of the muscle), and insert by means of a thin aponeurosis extending from just ventral to the lateral margin of the m. rectus abdominis, to the linea alba. As this aponeurosis passes superficial to the m. rectus abdominis, and at the linea alba, it is closely attached to the skin.

The most posterior of the series of myotomes forming the m. obliquus externus passes caudad and ventrad and makes two distinct insertions. The more dorsal fibers insert upon the fascia of the groin immediately anterior to the base of the hindlimb, whereas the ventral group of fibers passes deeper to insert in common with the posterior part of the m. obliquus externus (deep portion).

M. RECTUS ABDOMINIS: The m. rectus abdominis is broad, extending from approximately midway between the sulcus lateralis and the ventral midline, to the lateral margin of the linea alba; the muscle originates in three parts. The first part, a thin superficial layer, arises from a delicate sheet of connective tissue covering the m. pubo-ischio-femoralis externus, and is approximately three fourths the total width of the muscle. A second part originates from the anterior margin of the pubic cartilage just lateral to its midline. From this narrow origin, fibers fan slightly to mingle with those of the other two parts, but chiefly serve to form the deeper part of the muscle lateral to the linea alba. The third part of the m. rectus abdominis originates from a thin tendon, affixed to the latero-ventral aspect of the pubic cartilage and also serving for the insertion of the two posterior myotomes of the m. obliquus externus (deep portion), and the posterior myotome of the m. obliquus externus (superficial portion). From this tendon fibers of the m. rectus abdominis fan slightly and mingle with those of the superficial part of the m. rectus abdominis, but form chiefly the lateral third of the muscle.

The insertion of the m. rectus abdominis is difficult to ascertain for there is a more or less distinct break in the continuity of its fibers at each myocomma. Posterior and ventral to the base of the forelimb, however, fibers of the superficial part of the muscle intermingle with those of the m. pectoralis. The deeper part of the m. rectus abdominis immediately lateral to the linea alba, terminates in part on the dorsal surface of the sternal cartilage and contributes to the superfical part of the m. rectus cervicis. All of the remaining fibers of the m. rectus abdominis pass dorsal and lateral to the sternal cartilage and arbitrarily may be said to terminate at the myocomma near the anterior extremity of the sternal cartilage. Here these fibers may be said to give rise to the major part of the m. rectus cervicis.

M. OBLIQUUS EXTERNUS (DEEP PORTION): This muscle originates from the lateral processes of the trunk vertebrae, from the ribs and from the fascia of the sulcus lateralis. The anterior margin of the muscle is at the level of the anterior margin of the m. obliquus externus (superficial portion), and the posterior margin is a distance equal to the width of two costal folds anterior to the posterior margin of that muscle. Throughout its length the m. obliquus externus (deep portion) is composed of myotomes in which the fibers are directed almost longitudinally; the only notable deviation from this

occurs toward the ventral margin of the muscle where some fibers are directed slightly ventrad.

The m. obliquus externus (deep portion) has no single distinct insertion. There is a distinct break in the continuity of its fibers at each myocomma; from each myotome a few fibers at the ventral margin pass deep to the lateral margin of the m. rectus abdominis and mingle with the fibers on the internal surface of that muscle; and the two posterior myotomes of the muscle form a distinct part, the fibers of which insert by means of a thin tendon on the latero-ventral margin of the pubic cartilage.

M. Transversus Abdominis: The anterior margin of this muscle is at the same level as the anterior margin of the oblique muscle. The nine myotomes composing the anterior part of the m. transversus abdominis originate from the ventro-lateral surfaces of the lateral processes and centra of the trunk vertebrae. The last three or four myotomes forming the posterior part of the muscle, originate from the fascia of the sulcus lateralis. The fibers of the muscle extend ventrad and slightly craniad, terminating in a thin aponeurosis, which lies ventral to the lateral margin of the m. rectus abdominis. This aponeurosis, closely attached to the internal surface of the m. rectus abdominis and to the parietal peritoneum, extends to attach on the linea alba.

Musculature of the Pectoral Girdle and Forelimb

dorsal muscles

(The muscles of this group are all deep to the m. subarcualis rectus I, even though specific mention of the presence of this muscle may not be made in individual descriptions.)

M. Dorso-humeralis: This large, thin, triangular muscle originates from the fascia cephalo-dorsalis and the skin, from immediately dorsal to the dorsal margin of the suprascapular cartilage to the third costal fold. The fibers of the muscle converge markedly as they extend toward the head of the humerus, the more anterior fibers passing almost ventrad as they cross the suprascapular cartilage, while the more posterior fibers are directed cranio-ventrad. Dorsal to the proximal limit of the upper arm, the fibers of the m. dorso-humeralis terminate on a narrow flat tendon, which passes deep to the m. anconaeus humeralis lateralis, just dorsal to its origin, and inserts on the antero-dorsal aspect of the humerus just distal to its head.

M. Dorsalis Scapulae: This muscle, its posterior margin deep to the m. dorso-humeralis and its antero-dorsal margin deep to the m.

cucullaris, originates from the lateral surface of the suprascapular cartilage. The fibers of the muscle converge as they pass ventrad from the fan-shaped origin and immediately anterior to the insertion of the m. dorso-humeralis, they insert on the humerus.

M. CUCULLARIS: This muscle arises in two parts. The more anterior of these parts, designated as the cucullaris major, arises from the posterior surface of the quadrate immediately dorsal to the attachment of the ceratohyal, from the crista muscularis and from the operculum. This stout head, round in cross-section, passes caudo-ventrad to cross the posterior part of the m. cucullaris and inserts on the anterior surface of the base of the scapula.

The posterior part of the m. cucullaris, designated as the cucullaris minor, arises from a slip fused with the ventral surface of the m. longissimus capitis immediately posterior to the skull (this slip is almost worthy of consideration as a separate head), from the fascia cephalo-dorsalis, and from the antero-dorsal part of the lateral surface of the suprascapular cartilage. From this exceptionally broad origin, fibers of the cucullaris minor converge on a short flat tendon deep to the insertion of the cucullaris major, and by means of that tendon, insert on the lateral margin of the procoracoid cartilage near its base.

M. OPERCULARIS: This muscle originates from the postero-medial lip of the fenestra vestibulae as a slender round bundle of fibers. It passes obliquely caudad and laterad from its origin, becoming more superficial toward its insertion. The muscle passes immediately ventral to the ventral margin of the dorsal muscle mass, and anteriorly, it is deep to the mm. cucullaris (both parts) and depressor mandibulae posterior. Caudal to the posterior border of the muscle last named, the m. opercularis is covered by only the m. cucullaris minor. The m. opercularis broadens and thins toward its spatulate insertion on the antero-dorsal part of the lateral surface of the suprascapular cartilage.

VENTRAL MUSCLES

M. PECTORALIS: This is the most posterior of the ventral pectoral muscles. It is roughly triangular, sheetlike and is thinner anteriorly than posteriorly. The posterior third of the muscle may arbitrarily be said to originate from the myocomma of the third costal groove, for at this level superficial fibers from the m. rectus abdominis curve laterad and contribute to the m. pectoralis. The middle third of the muscle originates from the linea alba, and the anterior third from the ventral surface of the sternal cartilage near its midline. All fibers

from this fan-shaped origin converge on a short strong tendon which inserts on the posterior surface of the crista ventralis humeri.

M. Supracoracoideus: This fan-shaped muscle originates from the ventral surface of the coracoid cartilage along its medial border, and the posterior part of the muscle is overlapped by the m. pectoralis. The fibers of the m. supracoracoideus converge toward the proximal extremity of the humerus and insert on the crista ventralis humeri in common with the m. pectoralis.

M. Coraco-radialis Proprius: This muscle situated just deep to the m. supracoracoideus, originates on the ventral surface of the coracoid cartilage. The head of the muscle is thin and fan-shaped, and its line of origin is continuous with that of the m. coracobrachialis brevis. The fibers of the m. coraco-radialis proprius converge on a flat tendon which divides just medial to the shoulder joint. The lateral slip of this tendon inserts on the crista ventralis humeri, but the medial part of the tendon is long and enters the upper arm, passing between the mm. coracobrachialis longus and humero-antibrachialis to insert on the medial aspect of the radius just beyond its proximal limit.

M. Procoraco-humeralis: This muscle originates in two parts. The superficial head, thin and spatulate, arises from the ventral surface of the procoracoid cartilage just caudal to its anterior limit and passes caudad to insert on the anterior margin of the crista ventralis humeri. The deep part of the m. procoraco-humeralis is quite distinct from the part above. It originates from the ventral surface of the procoracoid cartilage near its midpoint, and passing deep to the superficial head, extends caudad to insert on the capsule of the shoulder joint and the proximal margin of the crista ventralis humeri.

M. Coracobrachialis Longus et Brevis: The long head (caput longum) of this muscle arises from the posterior part of the dorsal surface of the coracoid cartilage. The heavy bundle of fibers extends to insert along the middle third of the posterior surface of the humerus.

The short head (caput brevis) arises from the posterior third of the ventral surface of the coracoid cartilage and extends laterad over the shoulder joint to insert along the base of the posterior surface of the crista ventralis humeri.

The two heads are closely fused throughout, and are separable only with difficulty.

M. Subscapularis: This muscle originates on the internal surfaces of the scapulo-coracoid and two of its cartilages. The origin is fan-shaped and the thin sheet of fibers is attached to the ventral

part of the suprascapular cartilage, the scapula, the procoracoid cartilage and the coracoid. One slip of the muscle also originates from the posterior margin of the scapula. From the origin, fibers of the muscle converge to curve laterally at the posterior margin of the scapula and insert on the crista dorsalis humeri.

MUSCULATURE OF THE PELVIS AND THIGH

VENTRAL AND LATERAL MUSCLES

M. PUBO-ISCHIO-TIBIALIS: This muscle is distinctly divided into proximal and distal parts, continuous by way of a tendinous aponeurosis. The proximal part, the most superficial of the muscles on the ventral surface of the pelvic girdle, originates as a thin sheet from the pubo-ischiac plate immediately lateral to its midventral crest. The anterior margin of this part lies caudal to the anterior margin of the m. pubo-ischio-femoralis externus and the caudal margin is inseparably fused with the anterior margin of the m. ischio-flexorius. The proximal part of the muscle narrows slightly as it passes laterally over the pubo-ischiac plate to terminate in an aponeurosis at the level of the acetabulum. The anterior part of this aponeurosis attaches to the origin of the m. pubo-tibialis, forming a postero-medial support for that muscle, while the posterior part of the aponeurosis extends but a short distance before becoming continuous with the distal part of the m. pubo-ischio-tibialis. The distal part of the muscle, tapering slightly, extends distad in a midventral position in the thigh and inserts on the proximal half of the postero-ventral surface of the tibia.

M. ISCHIO-FLEXORIUS: This muscle too is composed of proximal and distal parts. The proximal part, almost inseparably fused with the posterior margin of the proximal part of the m. pubo-ischio-tibialis, lies superficially upon the posterior part of the pubo-ischiac plate and originates from the postero-lateral margin of that element. The fibers of this part converge as they pass laterad and terminate in a tendon just posterior and lateral to the aponeurosis dividing the m. pubo-ischio-tibialis, and immediately lateral to the aponeurosis of the m. caudali-pubo-ischio-tibialis as it crosses to insert upon the m. pubo-ischio-tibialis. The slender, spindle-shaped distal part of the m. ischio-flexorius extends from the distal extremity of this tendon and passes along the femur posterior to the m. pubo-ischio-tibialis, to insert by a delicate aponeurosis on the fascia of the flexor surface of the m. flexor primordialis communis.

M. PUBO-TIBIALIS: This muscle originates by a tendinous aponeurosis from the antero-lateral margin of the pubis immediately cranial

to the anterior margin of the m. pubo-ischio-femoralis-externus. The postero-medial aspect of the origin is strengthened by the attachment of a portion of the aponeurosis of the proximal part of the m. pubo-ischio-tibialis. From its origin the m. pubo-tibialis passes distad along the femur, just anterior to the distal part of the m. pubo-ischio-tibialis, and inserts on the proximal fourth of the antero-ventral surface of the tibia.

M. Ischio-caudalis: In the female this short, heavy muscle lies immediately lateral to the cloaca. It originates from the haemal spine of the second precaudal vertebra and from the myoseptum at the junction of the trunk and tail, and passes straight forward to insert on the posterior margin of the ischium just lateral to the ventral midline. Some of the fibers in contact with the lateral wall of the cloaca are firmly attached to it, but there is no break to indicate a distinct insertion thereto.

In the male the ischio-caudalis originates wholly from the ventral margin of the myoseptum mentioned above. The muscle is thin and ribbonlike, and from its origin, following the curve of the cloacal lip, it passes between the dorsal and ventral parts of the cloacal gland. The insertion is like that in the female.

M. Caudali-pubo-ischio-tibialis: In the female this muscle lies immediately lateral to the m. ischio-caudalis. Its origin is from the same parts as the ischio-caudalis, but slightly dorsal to the origin of that muscle. The caudali-pubo-ischio-tibialis is stout and straplike and passes antero-laterally to insert by means of a delicate aponeurosis upon the postero-lateral quarter of the fused proximal parts of the m. pubo-ischio-tibialis and m. ischio-flexorius.

In the male the muscle is thin and ribbonlike, and only a small slip from the dorsal margin originates from the haemal arch; the remainder of the muscle originates from the myoseptum. The body of the muscle is more superficial and further separated from the m. ischio-caudalis than it is in the female, due to its passage over the lateral surface of the dorsal part of the cloacal gland in this sex.

M. Caudali-femoralis: This muscle, situated just dorsal to the m. caudali-pubo-ischio-tibialis, originates in common with, and immediately dorsal to, the two preceding. In the female it extends antero-laterally, increasing slightly in diameter near its mid-point, then tapers toward its insertion. The latter is made by a narrow tendon which passes dorsal to the posterior margin of the distal part of the m. ischio-flexorius, and inserts on the external trochanter of the femur.

In the male the origin of the m. caudali-femoralis is similar to that in the female, but the muscle is not as stout as in the other sex, and curves about the lateral aspect of the dorsal part of the cloacal gland in passing to its insertion.

M. ILIO-CAUDALIS: This muscle is situated between the dorsal margin of the m. caudali-femoralis and the ventral margin of the m. dorsalis trunci. It originates chiefly from the myoseptum at the junction of the trunk and tail, though some of the deeper fibers arise from the lateral processes of the first and second caudal vertebrae. As a short thick bundle of fibers, the ilio-caudalis passes craniad to insert on the internal surface of the dorsal extremity of the ilium near its posterior border. The fibers of the muscle are interrupted by one myocomma in each sex, and the muscle is proportionally smaller in the male than in the female.

M. PUBO-ISCHIO-FEMORALIS EXTERNUS: This muscle, except for its anterior fourth, is covered by the fused proximal portions of the m. pubo-ischio-tibialis and m. ischio-flexorius. It originates from the pubo-ischiac plate along a line extending the full length of that element, immediately lateral to its mid-ventral crest. The m. pubo-ischio-femoralis externus, a broad thick sheet at its origin, narrows considerably as it passes laterad, crossing ventral to the origin of the m. abdominohyoideus. Deep to the juncture of the proximal and distal part of the m. pubo-ischio-tibialis, the m. pubo-ischio-femoralis externus turns abruptly dorsad to insert directly upon the trochanter.

M. PUBI-FEMORALIS: This muscle is short and heavy, and originates in two parts. The origin of the ventral head is from the dorsal aspect of the aponeurosis of the m. pubo-ischio-tibialis where it is attached to the origin of the m. pubo-tibialis. The dorsal head originates on the pubic cartilage from the process immediately anterior to the acetabulum. Fibers from the two heads unite and pass caudo-distad, crossing the posterior extremity of the insertion of the m. pubo-ischio-femoralis internus, and insert on the middle third of the antero-ventral surface of the femur.

M. ISCHIO-FEMORALIS: This short stout muscle originates from the lateral margin and postero-dorsal surface of the ischium posterior to the acetabulum. It passes cranio-laterad to insert on the posterior surface of the head of the femur.

DORSAL MUSCLES

M. ILIOFIBULARIS: This long slender muscle originates from a short heavy tendon attached to the postero-lateral surface of the

ilium immediately ventral to the union of that bone with the iliac cartilage. From its origin the m. iliofibularis extends distad in the thigh, crossing the posterior border of the femur, and passes ventro-lateral to the knee capsule. The muscle inserts on the postero-ventral margin of the fibula, just distal to the knee.

M. Extensor Iliotibialis: This muscle is composed of two parts, ovoid in cross-section and separate throughout the greater part of their extent. Both parts are slender. The posterior head originates in common with the m. iliofibularis; the anterior head originates at the same level from the antero-lateral surface of the ilium. The two parts immediately approximate along the middorsal surface of the femur, but show no sign of fusion except just proximal to the tendon of insertion. This tendon, broad at its attachment to the muscle, passes distad on the dorsal surface of the knee capsule (to which it shows no attachment) and enters the shank between the mm. extensor digitorum communis and extensor cruris tibialis. Much narrower at its distal extremity, the tendon inserts on the anterior spine of the tibia.

M. Pubo-ischio-femoralis Internus: This muscle originates as a broad sheet from just lateral to the middorsal line of the pubic cartilage for its full length, and from the antero-medial part of the dorsal surface of the ischium. The fibers of the muscle converge as they pass laterad from their origin. At the angle formed by the union of the ilium with the pubic cartilage, the m. pubo-ischio-femoralis internus twists; the posterior part of the muscle curves about the base of the ilium immediately cranial to the m. extensor iliotibialis, and the posterior part of the muscle curves ventrad over the antero-lateral margin of the pubic cartilage. The m. pubo-ischio-femoralis internus covers the anterior surface of the head of the femur and inserts on an elongate area bounding that structure ventrally and distally. The longest fibers of the muscle insert on the dorsal surface of the femur and extend no farther distad than the mid-point of that bone.

A few fibers from the antero-dorsal surface of the m. pubo-ischio-femoralis internus insert on a long delicate tendon which extends distad to its insertion on the antero-dorsal surface of the knee capsule. This part of the muscle probably represents the m. pubo-extensorius of Low (1926) and Francis (1934).

M. Iliofemoralis: This muscle originates as a thin fan-shaped sheet from the postero-medial surface of the ilium and the antero-lateral part of the dorsal surface of the ischium. As the fibers extend postero-dorsally from their origin, they converge into a round

bundle at the posterior angle formed by the junction of the ilium with the ischium. At this point the m. iliofemoralis turns abruptly ventrad over the margin of the ischium anterior to the m. ischiofemoralis and posterior to the origin of the m. iliofibularis, and then extends ventrad and distad on the posterior surface of the femur to insert on the external trochanter in common with the m. caudalifemoralis.

COMPARISON OF OTHER SPECIES WITH PSEUDOEURYCEA BELLII

In making the following comparisons with *P. bellii,* I have excluded differences that I consider the probable result of age, seasonal modification or individual variation. Secondary sexual modifications have been noted and allowance made for them.

EXTERNAL ANATOMY: The general coloration of *gigantea** closely resembles that of *bellii,* but no maculations are present in the parietal region. In *cochranae, robertsi* and *gobeli* there are ground colors of gray or tannish gray and some degree of broad orange or reddish striping. Irregular, light, dorsal and dorso-lateral flecking on a slate or slate-black ground color is characteristic of *leprosa* and *cephalica; rex* is an almost solid grayish tan, and *smithi* and *gadovii* are grayish tan dorsally but markedly lighter ventral to the sulcus lateralis.

The relative width of the head, as shown by the relation of the width of the eyelid to the interorbital width, is reduced from the condition in *bellii* in all species examined. In *bellii* the width of the eyelid is contained approximately 1.6 times in the interorbital width; in *rex,* 1.5; in *leprosa,* 1.4; in *robertsi,* 1.2; in *cochranae, cephalica* and *goebeli,* 1.0; in *smithi,* .93; in *gadovii,* .86; and *unguidentis,* .84.

The postocular groove is straight in *cephalica,* touches the gular fold ventral to its juncture with the postocular groove in *gadovii,* and in *smithi,* its anterior extremity touches the angle of the eye. The first gular grooves can be traced completely across the ventral surface of the throat in all species except *smithi,* in which they are indistinct and cannot be traced beyond the angle of the jaw. These grooves are not discernible above the postocular groove in *smithi* or in *gadovii.* The gular fold is deep in *cephalica,* reduced in *gigantea,* and is barely marked by folding of the skin in *leprosa.*

The costal grooves are well-marked and meet ventrally in *gadovii, smithi* and *unguidentis;* they extend almost to the mid-

* Color names are general and do not refer to a specific standard.

ventral line in *cephalica,* but are faint and are not visible on the venter in *rex, goebeli* or *leprosa.* In *gadovii,* the costal grooves extend and fork slightly above the sulcus lateralis, and in *smithi* and *unguidentis,* they are continued above the sulcus by Z-shaped grooves, which extend to the middorsal line.

A distance equal to the width of three to four costal folds separates the digits of the adpressed limbs in *smithi* and *rex;* in *leprosa, robertsi* and *cochranae* the distance is equal to the width of two to three costal folds; and in *gadovii* and *unguidentis,* the distance varies from equal to the width of one to two costal folds to overlapping of the digits. The distance separating the digits of the adpressed limbs in *cephalica* is constant and equal to the width of one to two costal folds. The webbing of the digits involves the greater part of the proximal phalanges, and may be extended to the basal part of the second phalanges in *cephalica.* In *unguidentis, gadovii* and *smithi,* the webbing at the base of the proximal phalanges is slightly less evident than in *bellii.*

The tail is as long as, or slightly shorter than, the distance from the snout to the posterior margin of the anus in *smithi, gadovii* and *unguidentis,* but in the other species examined, the tail is only slightly longer than the length of the trunk alone. The constriction at the base of the tail is not well marked in *leprosa, goebeli* or *rex.*

The ridge of the m. subarcualis rectus I extends to touch the third costal groove in *smithi, gadovii* and *unguidentis;* in *leprosa, robertsi, cochranae, rex* and *goebeli,* the ridge extends to midway between the second and third costal grooves, and in *cephalica* its posterior extremity touches or falls just short of the first costal groove.

The postiliac gland is faint in *smithi,* and in *smithi, gadovii* and *unguidentis,* there is marked enlargement of the parietal region of the head, more evident in males than in females.

BUCCAL CAVITY: The palatine surface of the mouth differs markedly in *smithi,* for midway between the openings of the internal nares, there is a rounded opening approximately as large as the narial opening. This marks the termination of the duct of a well-developed internasal gland located in the fronto-premaxillary fontanelle. In *gadovii* and *unguidentis,* the opening is present but minute, and is surrounded by a narrow area where the mucous is unusually porous. In other species examined, only the porosity in the mucous membrane can be discerned between the nares; the internasal gland is more highly developed in all of these than in *bellii,* but has no distinct duct.

The internal nares are round in *smithi* and *cephalica;* in the latter the narial openings are unusually large and are situated anterior to the lateral extremities of the prevomerine tooth-rows. The latichoanal fissure is deep in *cephalica* and extends past the posterior limit of the maxilla to terminate near the posterior limit of the pharynx. In *unguidentis, gadovii* and *smithi,* the fissure originates from the postero-lateral margin of the narial opening.

Only six to eight premaxillary teeth are present in females of *leprosa, robertsi, cochranae, rex, goebeli, gadovii, smithi* and *unguidentis;* in males of the three species last named, usually only three enlarged premaxillary teeth penetrate the lip. There is probably some variation in the number of enlarged teeth in males of the other species, for in the specimens examined, from two to five were noted, although the usual number was four. The premaxillary teeth in males of *gadovii* show a marked enlargement of the subterminal point and from the lateral aspect, resemble an inverted "Y" in shape. In males of *smithi* and *unguidentis,* these teeth show even more modification, for the subterminal point curves caudo-ventrally and comes to lie antero-ventral to the terminal point.

The maxillary and mandibular teeth are noticeably larger in *gadovii, smithi* and *unguidentis* and the number of these teeth is considerably reduced. Only 22 to 24 mandibular teeth are present in each, and the maxillary teeth number from 18 to 24. Excepting the teeth of the premaxilla, the teeth have no discernible subterminal points in these species.

In *leprosa, goebeli* and *rex,* 11 to 13 teeth are present in the slightly curved prevomerine series; in *cochranae* and *robertsi* the prevomerine rows are nearly straight and carry 9 to 11 teeth. The prevomerine rows are broadly curved in *gadovii, unguidentis* and *smithi;* 10 or 11 prevomerine teeth are present in the two species first named, and 12 to 14 are present in *smithi.* In *cephalica,* curvature of the prevomerine rows is barely discernable, and the 13 to 15 teeth are arranged in short discontinuous series. In *cephalica,* all teeth are tipped with black and the tongue is attached at its anterior extremity.

The rows of teeth on the paravomers are arranged to form distinct cranially-directed chevrons in *gadovii, smithi* and *unguidentis.*

SKULL: The proportion of the over-all length of the skull to its greatest width (measured at the points of articulation of the quadrates), is increased over the condition in *bellii* in all species examined. From 1.5 in *bellii,* the proportion rises to 1.8 in *leprosa* and *cephalica,* 2.0 in *gadovii,* 2.1 in *smithi* and 2.25 in *unguidentis.*

In *leprosa* the frontal processes of the premaxilla are round and slender anteriorly, flattened at their posterior extremities and are parallel to each other. These processes articulate only loosely with the nasals, posterior parts of the prefrontals and anterior tips of the frontals. In *cephalica* these processes are slightly heavier, diverge mildly toward their posterior extremities, and are more firmly attached to the frontal. The frontal processes of the premaxilla in *unguidentis* are similar in shape to those of *cephalica,* but posteriorly, one half their length overlaps and articulates with the frontal. In *gadovii* these processes are slightly compressed laterally at their posterior extremities, which articulate with the frontal and form a slight lateral wall for the posterior part of the fronto-premaxillary fontanelle. In *smithi* the frontal processes of the premaxilla are heavy and laterally compressed throughout their length. Posteriorly they articulate with ventrally-curved processes of the frontals, and together with those parts, form lateral walls for the fronto-premaxillary fontanelle. In *unguidentis, gadovii* and *smithi,* the premaxilla is firmly articulated with the maxilla.

There is a progressive increase in the degree of ossification of the prefrontals and nasals, and a concurrent increase in the relative proportion of the size of the former to the size of the latter in *cephalica, unguidentis, gadovii* and *smithi.* The ridge of the posterior vertical semicircular canal is prominent in *unguidentis,* and the medial extremity of the anterior ridge bears a small but distinct crest. The posterior vertical semicircular canal is crested throughout its length in *gadovii,* and in *smithi* the crest is high, extends the full length of both the anterior and posterior ridges, and is medially continuous between the two. In *gadovii* and *smithi* the posterior margin of the parasphenoid is angular rather than curved, and the articulation with the ventral surfaces of the otic-occipitals is markedly stronger.

A small oval opening is present between the medial margins of the prevomers in *leprosa* and *cephalica.* This opening is progressively increased in size, and the cartilage forming the articulation between the prevomers is progressively reduced in *unguidentis, gadovii* and *smithi.* This intervomerine foramen lies posterior to the fronto-premaxillary fontanelle in *leprosa* and *cephalica,* but is ventral to the posterior part of the fontanelle in *unguidentis* and *gadovii.* In *smithi* the intervomerine foramen lies directly beneath the fronto-premaxillary fontanelle.

The coronoid process of the angulare is markedly longer and higher in *smithi, gadovii* and *unguidentis,* and in these species the

articulating part of Meckel's cartilage shows slight calcification, but the articulare does not appear as a separate element.

OTHER SKELETAL PARTS: The length of the hyobranchial apparatus in relation to the length of the head and trunk is slightly reduced from the condition in *bellii* in all species examined. Less reduction is shown in this respect in *smithi, gadovii* and *unguidentis* than in *leprosa* and other members of its species group. In *cephalica,* there is not only reduction in the relative length of the hyobranchial apparatus, but the relationships between the lengths of its component parts are changed as well. The ceratobranchials are markedly shorter than the basibranchial and the epibranchials are less than twice as long as the basibranchial in that species.

In *smithi, gadovii* and *unguidentis* the neural spine of the cervical vertebra is markedly more ossified, and in these three forms the neural spines of the trunk vertebrae are markedly lower than in *bellii.* Neural spines are present only on the first three trunk vertebrae in *cephalica,* and in *leprosa,* neural spines are completely absent. Only in *cephalica* are there cartilages similar to those replacing the last pair of ribs in *bellii;* in all other species examined, the last pair of ribs is completely absent and the lateral processes have no evidence of articulating surfaces. The first two or three pairs of ribs are broadened distally but not forked, in *leprosa, cephalica, gadovii, smithi* and *unguidentis.*

In *gadovii* and *smithi* the ischia are relatively larger, and are notched posteriorly, leaving a heavy posteriorly-projecting process behind the acetabulum. In *gadovii* the synchondrosis between the ischia is narrow, and in *smithi* the ischia are nearly in contact in the median plane.

HYOBRANCHIAL MUSCULATURE: The m. intermandibularis anterior is fused to the m. intermandibularis posterior only toward its lateral extremities in *leprosa, cochranae* and *robertsi;* in *gadovii* the muscle has distinct attachment to the dentary rather than to the fascia; and in *smithi* and *unguidentis,* the muscle is reduced or absent. The m. geniohyoideus lateralis is attached dorsally to the floor of the mouth but has no insertion in that area in *smithi, gadovii* or *unguidentis.* The m. abdominohyoideus differs markedly in *cephalica;* in that species, the muscle is reduced and no spiral coiling is present at the posterior limit of the basibranchial. The m. suprapeduncularis is also reduced in *cephalica.*

MANDIBULAR MUSCULATURE: The m. depressor mandibulae posterior is markedly broader at its origin in *leprosa, robertsi* and *cochranae;* in these forms the posterior part of the muscle lies dorsal to the

anterior margin of the suprascapular cartilage. In *smithi* and *unguidentis* the muscle is slightly enlarged and originates closer to the m. depressor mandibulae anterior. The latter is also enlarged in *smithi* and originates partly from the lateral extremity of the crista muscularis. The mm. levator mandibulae externus is thin in *cephalica* but slightly wider than in *bellii*. In *unguidentis*, all of the mandibular levators show some enlargement. The m. levator mandibulae externus is heavier, and the levator mandibulae anterior (deep portion) originates slightly anterior to the point of origin noted in *bellii*. The m. levator mandibulae externus, levator mandibulae posterior, and levator mandibulae anterior (superficial portion) fuse slightly near their insertions. In *gadovii* the enlargement of these muscles is still more marked, the m. levator mandibulae anterior (deep portion) originates from the anterior half of the dorsal margin of the orbit, the insertions of the muscles are made along the entire posterior half of the mandible, the fusion of the three muscles extends as far dorsally as one third the length of the m. levator mandibulae externus. In *smithi* this group of muscles reaches its greatest development. All muscles of the group are greatly enlarged, originate and insert as in *gadovii*, and are fused inseparably beneath the m. levator mandibulae externus. In *gadovii* and *smithi*, the development of mandibular levators is noticeably greater in males than in females.

MUSCULATURE OF THE GIRDLES AND LIMBS: The m. opercularis is slightly reduced in *leprosa, robertsi, cochranae* and *cephalica;* in *unguidentis, gadovii* and *smithi* the muscle is reduced, partly fused to the m. dorsalis trunci, and originates more medially on the otic-occipital. The m. cucullaris is considerably enlarged in *gadovii* and *smithi*.

In the pelvic girdle and limb, the m. ischio-caudalis is enlarged and originates wholly from the myoseptum between the trunk and tail in *cephalica* and *gadovii*. The m. iliocaudalis is partly fused with the m. dorsalis trunci in *unguidentis*, and in *gadovii* and *smithi*, the two muscles are inseparably fused. The two heads of the m. extensor iliotibialis are fused slightly in the distal two thirds of their length in *unguidentis* and *gadovii*, and in *smithi* they fuse immediately distal to their origins. The m. pubo-ischio-femoralis internus is narrower at its origin in both *smithi* and *gadovii;* in the former the origin is from the anterior half of the puboischiac plate, while in the latter, the origin covers the anterior two thirds of the plate.

SUMMARY AND CONCLUSIONS

The general anatomy of *Pseudoeurycea bellii* is recorded for the first time. A concentration of subcutaneous glands postero-dorsal to the insertion of the hindlimb is designated the *postiliac gland;* a cleft, which curves caudo-laterad from the lateral margin of the opening of the internal naris, is termed the *latichoanal fissure;* and it is suggested that the name *precaudal vertebrae* be used to designate the transitional vertebrae immediately posterior to the sacral vertebra. The m. depressor mandibulae is found to be divided into two muscles, each supplied by a separate twig from the seventh cranial nerve; these two muscles are designated as the *m. depressor mandibulae posterior* and *m. depressor mandibulae anterior.*

Anatomical comparisons of certain other species (*gigantea, rex, goebeli, cochranae, robertsi, cephalica, gadovii, unguidentis* and *smithi*) with *P. bellii,* show unquestionably that all are properly referred to the same genus. The structural relationships of elements of the skull are identical; the only differences found in the cranial structure involve the degree of ossification of the bony parts, the positional relationships of certain structures and the development of crests on the otic-occipital. Variations in the vertebrae, in bony elements of the girdles and limbs, and in the anatomy of soft parts certainly do not fall outside generic limits as they are now understood.

Within the genus, four lines of development are indicated. It is inferred that all four lines stem from a common ancestral stock probably referrable to the genus *Pseudoeurycea.* The most primitive line, represented by *bellii* and *gigantea,* shows no well-marked sexual dimorphism, has cartilaginous remnants of the last pair of ribs, and shows little development of the internasal gland and its foramen between the vomers. *Pseudoeurycea leprosa, rex, goebeli, cochranae* and *robertsi,* fall into a second group which is but slightly more advanced. No well-marked sexual dimorphism is evidenced in this group, but the last pair of ribs is completely lost, the elements of the skull are well ossified, and there is better development of the internasal gland and its foramen than in *bellii* or *gigantea.*

Pseudoeurycea cephalica and its subspecies represent a third line of development and show more specialization than either of the two groups mentioned above. A primitive characteristic is the retention of the cartilaginous remnants of the last pair of ribs; nevertheless the hyobrancial apparatus is modified, the digits are more fully webbed than in any other species of the group, and there

is more external sexual dimorphism evidenced in this species than by any other. These three characteristics are considered to be modern as opposed to primitive. The characteristic arrangement of the prevomerine teeth into discontinuous short series (resembling patches in some) is further evidence of specialization, probably the result of some food habit requiring strengthening of the holding abilities of these teeth, although the actual food habits of this species are not known.

In *Pseudoeurycea unguidentis, gadovii* and *smithi* there is a progressive increase in the size of the mandibular levators and secondary sexual modification of these muscles as well. Three series of progressive structural modifications are clearly correlated with the enlargement of the mandibular levators. The modifications are: (1) increase in the size of the crests on the otic-occipital; (2) increase in the size of the coronoid process of the angulare; and (3) increase in the degree of the calcification of the posterior part of Meckel's cartilage. Also there is a progressive increase in the degree of development of the subterminal point on premaxillary teeth in males, and the internasal gland is progressively better developed and reaches its peak in *smithi.* Fusion of the m. iliocaudalis to the m. dorsalis trunci in each of these three species is additional indication of their close relationship.

In final analysis, the genus *Pseudoeurycea* Taylor comprises a series of species that form a natural group. Anatomical findings indicate that there are four species groups within the genus, the species of each group having undergone a series of modifications which clearly differentiate them from species of the other three groups. The group represented by *P. cephalica* is perhaps the most specialized externally. The group represented by *P. gadovii, unguidentis* and *smithi* have undoubtedly undergone development along the line of specialization of the mandibular levators, and the progressive nature of this development and similarity of sexual dimorphism in the premaxillary teeth warrants their inclusion in the same species group. The inclusion of these three species in the same species group differs from the arrangement proposed by Taylor (1944:209) in that he placed *smithi,* separately, in a fifth species group.

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PLATE XXVI

Dissection of the hyobranchial musculature of *Pseudoeurycea bellii*. (× 7).

a. mandible
b. m. rectus cervicis (cut)
c. ceratobranchial I
d. basibranchial
e. ceratobranchial II
f. ceratohyal
g. m. abdominohyoideus (major part)
h. m. abdominohyoideus (slip)
i. m. subarcualis rectus I
j. epibranchial

PLATE XXVI

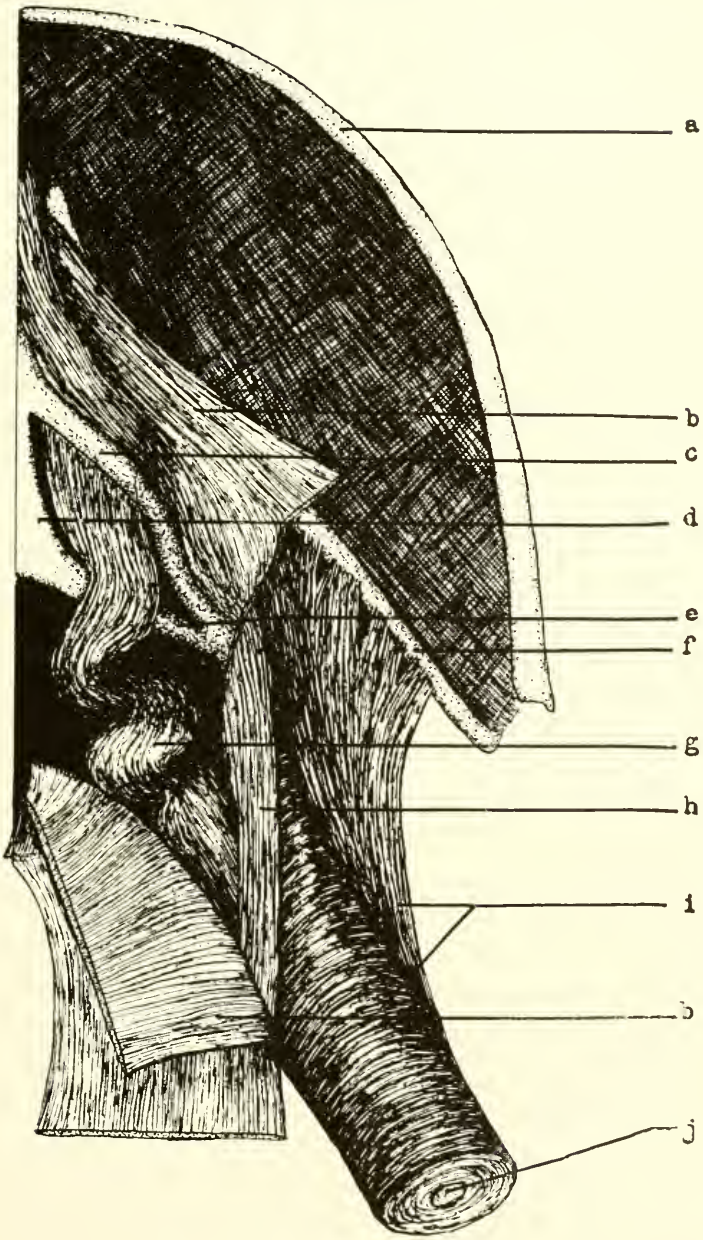

PLATE XXVII

FIGS. 2-14. Disarticulated bones of the skull and the cervical vertebra of *Pseudoeuryeea bellii*. ($\times 4\frac{1}{2}$).

FIG. 2. Premaxilla—lateral.
FIG. 3. Premaxilla—dorsal.
FIG. 4. Maxilla—lateral.
FIG. 5. Frontal—dorsal.
FIG. 6. Prevomer—ventral.
FIG. 7. Orbito-sphenoid—medial.
FIG. 8. Squamosal—lateral.
FIG. 9. Parietal—dorsal.
FIG. 10. Quadrate—medial.
FIG. 11. Parasphenoid—ventral.
FIG. 12. Atlas—ventral.
FIG. 13. Atlas—dorsal.
FIG. 14. Otic-occipital—dorsal

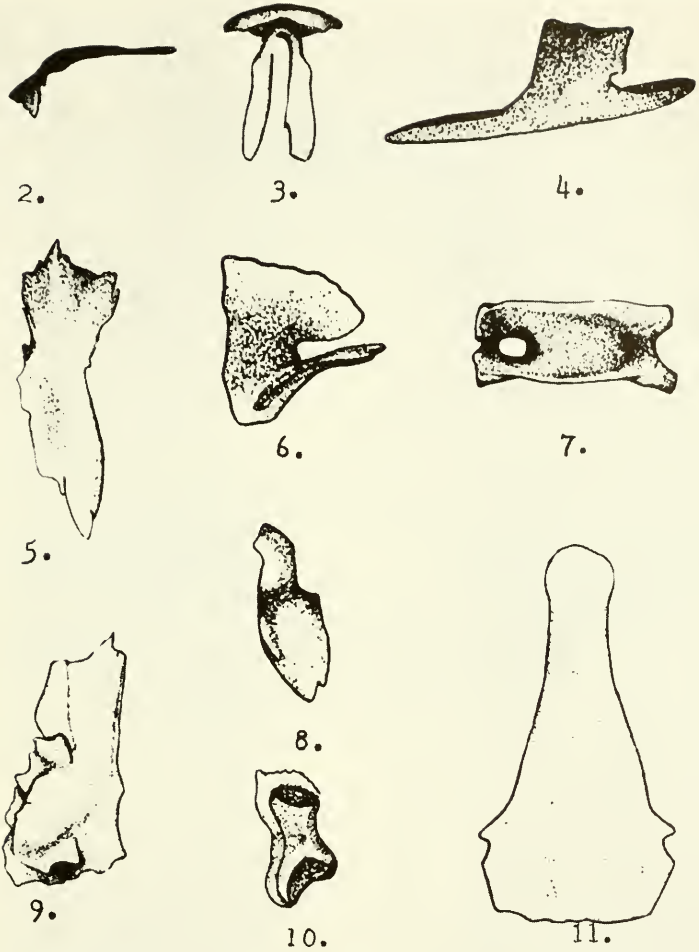
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PLATE XXVIII

FIGS. 15-19. Lateral views of representative vertebrae of *Pseudocurycea bellii*. (×6).

FIG. 15. Tenth trunk vertebra.
FIG. 16. Sacral vertebra.
FIG. 17. First precaudal vertebra.
FIG. 18. Second precaudal vertebra.
FIG. 19. Fourth caudal vertebra.

PLATE XXVIII

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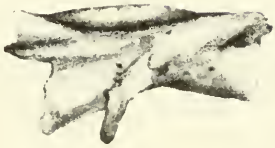

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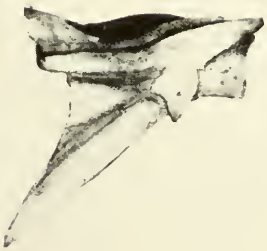

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The Estrous Cycle in the Woodrat, *Neotoma floridana*

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ABSTRACT: This species of woodrat has year round, spontaneous estrous cycles that are usually four to six days long. Leucocytes are almost always present in the vaginal smears and epithelium, especially at the caudal end of the vagina. Cornification does not occur, except at the external orifice which may contribute cornified cells to the smears at any time of the cycle. There is usually extensive mucification of the epithelium in the middle and cephalic regions of the vagina at the time of ovulation, followed by a predominance of vacuolated cells in the smears. Later stages of the cycle are similar to those in other rodents.

INTRODUCTION

The vaginal smear has been applied to many mammals since Stockard and Papanicolaou ('17) first used it to indicate the stages of the estrous cycle of the guinea pig. Outstanding contributions with this method were also made by Long and Evans ('22) on the rat and Allen ('22) on the mouse.

The stages in the cycle are designated in most rodents by the relative numbers of cornified and "pavement" epithelial cells and by the presence or absence of leucocytes in the smears. The time of heat, or estrus, is recognized by the presence of only cornified cells in the smears. Of the wild rodents, a similar vaginal smear picture was found by Clark ('36a) in the deer mouse; by Clark ('36b) in the cotton rat; by Foster ('34) and Coco ('42) in the ground squirrel; by Deanesly and Parkes ('33) in the grey squirrel; and by Parkes ('31) in the Chinese hamster.

Deanesly ('38), Kent and Smith ('45), Sheehan and Bruner ('45), and Ward ('46) have found some differences in the degree of cornification and time of heat in the golden hamster.

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Donat ('33) and Wood ('35) made vaginal smears on two subspecies of the woodrat, *Neotoma fuscipes*. Leucocytes and epithelial cells were found to dominate the smears most of the time and cornified cells appearing only in small numbers. The woodrats were considered to remain in the diestrous interval, and they concluded that the female does not have a regular cycle in captivity, or where there is no stimulus from a male.

A more thorough investigation seemed desirable, in order to compare the woodrat with other rodents and learn more about the changes during the estrous cycle.

MATERIALS AND METHODS

The woodrats used in this study were caught with live traps in the vicinity of Lawrence, Douglas County, Kansas. They were kept separated in individual metal cages in a room that was dark most of the time. Some of them were placed under a small roof outside during warm weather. One female was kept for five months in a large outdoor cage that had been constructed especially to simulate natural conditions. Two woodrat houses of sticks and stones had been transported intact and placed on the ground of the cage for her to live in.

Purina Fox Chow and water were available to the captive woodrats at all times; and supplemented by lettuce, cabbage, carrots, grass or some other green feed once or twice a week. The diet seemed to be adequate for good health and growth.

Vaginal smears were made from thirteen adult female woodrats, some being made during every month of the year except September and October. The smears were made once daily, except during one series from woodrats No. 3, No. 6, and No. 8, when they were made twice a day for a month. Nine adult females were sacrificed and the reproductive organs removed for sectioning. Eight of them were killed at known stages of the estrous cycle, after a series of daily smears had been made. One that was in early pregnancy was sacrificed the same day she was caught.

The genital tracts were stretched gently and laid on a flat cork, where they remained adhered and straight while being fixed in Bouin's solution. Serial sections were made of the ovaries and oviducts at 10 micra and stained with Harris' hematoxylin and eosin. Longitudinal sections were made through the lumen of the vagina for its entire length, including the cervix and a short portion of the two uterine horns. The contents of the lumen remained in position and could be seen in the sections. That made it possible to tell

where cells were desquamating and mucus was being formed. Several sections were made and stained with hematoxylin and eosin, a rapid trichrome stain (Pollak, '44), and Mayer's muci-carmine as a test for mucin. Half of the vagina from one woodrat was fixed in absolute alcohol and stained with Best's carmine for glycogen, and the other half was fixed with formalin, cut with the freezing microtome and stained with Sudan IV for fat.

A cone-shaped woodrat holder was made of half inch hardware cloth into which they could be maneuvered head first and held snugly while taking the vaginal contents. After wetting a medicine dropper with physiological salt solution, it was inserted about one-half inch into the vagina and suction applied while withdrawing slowly. When no sample was obtained on the first try, a drop of the saline was expressed into the lumen and withdrawn by the dropper to wash out a sample of the cells. This method has the advantage of taking most of the contents of the lumen, thus obtaining a sample from all parts of the vagina and not having much left there to be included with the next smear.

The sample was then spread on a microscope slide and immersed for five minutes or more in a solution of half and half 95 per cent ethyl alcohol and ether to fix the smear. Most of the smears were stained with the rapid trichrome, as a counter-stain to Harris' hematoxylin, and some with hematoxylin and eosin. A few duplicate smears were fixed with osmic acid fumes and Flemming's solution or fixed in formalin and stained with Sudan IV to test for fat in the vacuolated cells.

The types of epithelial cells in the smears are described, based on Hartman's ('44) classification. Four of the types vary in number during the cycle and are used to designate the stages. Unless otherwise indicated, descriptions of epithelial cells in smears and sections of the vagina are based on the trichrome stain.

Four stages in the estrous cycle are based on vaginal smears and a description made of the vaginal epithelium of the woodrats killed during each stage. A summary of each of these animals is given in Table I. The relative thickness of the vaginal epithelium is indicated by + to + + + +, and the cell types that make up the superficial layers of the epithelium are listed for each part of the vagina. Follicles over 0.8 mm. in diameter seem to be significant to the cycle in progress and are tabulated. The youngest sets of corpora lutea are briefly described and the eggs in the oviducts listed.

The corpora lutea are divided into the following age groups: (*a*) those with blue lutein cells and cavities that become progressively smaller; (*b*) those with light blue lutein cells and connective tissue in the centers; (*c*) large ones with pale lutein cells and a few fibrocytes; (*d*) those with pale lutein cells and many fibrocytes; (*e*) small ones with few lutein cells and mostly fibrous tissue. The corpora lutea that are known to be forming from follicles that have not ovulated appear to develop later in the cycle and are apparently supplementary to the ones formed from ovulated follicles.

The writer wishes to acknowledge the assistance of Drs. Homer B. Latimer and Paul G. Roofe in reading the manuscript and making many suggestions, and Paul N. Wilkinson for making the photomicrographs.

CELL TYPES OF THE VAGINAL EPITHELIUM

Hartman ('44) describes the cell types found in vaginal smears from the rat, using a similar trichrome stain. Most of the types can be recognized in the woodrat and his system will be used in order to recognize the similarities and have a point of departure for the difference between the two rodents. The following description of the cell types will be based on their appearance in the woodrat, using the trichrome stain.

Cell types I, II and III are considered to be representative of the "cornified series," and the rest we shall group in the "oval series." The cells of the "cornified series" are larger and flatter than the others. Those of the "oval series" correspond to those of the "atrophic series" in monkeys and women (de Allende, Shorr and Hartman '43, Plate I, type I), and the small cells found in the dog during anestrum (Evans and Cole '31, Fig. 2).

Cell Type I. These are Hartman's "scales" and the cornified cells of other authors. They are large, red or orange, having no visible or barely visible nuclei, and often showing wrinkles, folds or lines through the cytoplasm.

Cornified cells often make up about five or ten percent of the cells in the smear (Fig. 2a), but seldom more than twenty percent. No consistant variation in number is recognized in the woodrat and they are not used as an indicator of any stage in the vaginal cycle. In the sections they are seen only at the external orifice of the vagina, where they are continually being dehisced in layers like the skin.

Cell Type II. These are Hartman's "shorr cells," which he de-

scribes in the rat as being large with "blue or blue-green to gray cytoplasm, and large vesicular nuclei." A few large cells may be seen in smears from woodrats at any time of the cycle that fit his description, but the size of the nuclei grades down to the small dark nuclei of the more prevalent precornified cells. Both kinds probably arise from the transition zone between the cornified area at the external orifice and the vagina proper (Fig. 9).

Cell Type III. These are pre-cornified cells with large basophilic granules in the cytoplasm. They apparently come from the stratum granulosum seen under the cornified layer at the external orifice and the transition zone between that cornified area and the vagina proper. These, like Types I and II, may be seen in the smear at any stage of the cycle.

Cell Type IV. Hartman calls them "mucous cells," but his description fits the vacuolated cells seen in the smears and lumen of the woodrat, which are negative for mucin. This type may be subdivided into two classes:

Class 1. These are mucous cells, which are seen forming a superficial layer of tall columnar cells along the middle and cephalic regions of the vagina during Stages 1 and 2 (Figs. 3 and 7). Muci-carmine stains them red, as well as the strands of mucus secreted by them into the lumen. Only fragments of these cells have been recognized in the lumen and smears, and they appear to be used up in the process of secretion.

Class 2. These are vacuolated cells, which stain green or blue. When they first appear during the cycle there are a few small vacuoles scattered around in the cytoplasm (Fig. 5). By the time they are plentiful enough to indicate Stage 2, the vacuoles are large and appear to replace the cytoplasm, compressing the nuclei to one side or to the center (Fig. 6). They resemble the "foam cells" Evans and Cole ('31) found in the dog during anestrum.

The vacuoles can not be seen until the cells are sloughed off into the lumen, when Bouin's fixative and trichrome or hematoxylin and eosin stains are used on sections of the vagina. For that reason the cells are not identified in the epithelium, except in the part of the vagina of Woodrat No. 26 that was fixed in alcohol. Sudan IV stain, on frozen sections of formalin-fixed tissue from the middle part of the vagina from that same woodrat, shows many cells deep to the mucous layer which contain small fat droplets. Muci-carmine colors the strands of mucus among the cells in the lumen, but the vacuoles are negative.

In the smears, the vacuoles are prominent when alcohol-ether has been used as a fixative, and they look like the spaces left when fat droplets have been dissolved away. For some unknown reason, however, the vacuoles are negative for fat with osmic acid fixation, and with Sudan IV on formalin fixed smears.

Cell Type V. These are Hartman's "phagocytized cells," containing polymorphonuclear leucocytes. One or more leucocytes may occur in vacuoles in any of the cells of the oval series, (Figs. 4b and 12a), but they are usually in the vacuolated cells or the "dense" cells (Type VI, Class 1). Sometimes a cell is seen to have many leucocytes in a large vacuole.

Cell Type VI. These are called "other epithelial cells" by Hartman. He divides them into six classes, some of which are important in the woodrat.

Epithelial Cells, Class 1. Hartman describes them as "dense cells, often red-purple in color, with full nuclei." The woodrat has many cells fitting that description at certain stages of the cycle (Fig. 2d). Some are seen to take the red stain in a small part of the cytoplasm around the nuclei, where it often looks like a dense flocculate (Fig. 6a); others have more of the cytoplasm stained red, tending to obscure the nuclei; and others are completely red and the nuclei not visible. The nuclei can be seen when hematoxylin and eosin stain is used, even though the cytoplasm takes a dense red.

There are other cells that resemble the red staining dense cells, except that they stain green. They occur in the smears at the same time of the cycle, and the color difference does not seem to be sufficient reason for placing the green staining ones in a separate class.

Epithelial cells, Class 2. Hartman describes them as degenerating "deep cells" with misshapen pyknotic nuclei. In the woodrat there are two kinds that fit in this class: One staining light green (pink with H and E) and the other red-orange (dark red with H & E). In both kinds the nuclei are small, dark, often irregularly shaped or fragmented, and the cells are small.

At no time during the cycle are they seen to form a definite layer in the sections of the vagina, but are mixed at random with other types near the surface of the lumen during Stages 2 and 3 (Figs. 7a and 10a).

One or more of either kinds of the "deep" cells may be seen in lacunae in the epithelium. Sometimes leucocytes are seen with them in larger spaces. In the lumen and in the smears many of

them appear to be inside other cells, usually surrounded by a vacuolar space. Some cells are seen to contain two or three of them (Fig. 8a).

Epithelial cells, Class 3. These are Hartman's "red epithelial cells". Some smears from woodrats contain many red cells, but they do not appear consistently during the cycle and are probably due to variations in stain differentiation.

Epithelial cells, Class 4. These are Hartman's "proestrous cells." The cells of the woodrat which appear during Stage 1 (Figs. 2c and 4a) are among the largest of the "oval series," but are small compared with the cells of the "cornified series." They stain green or bluish-green, have large vesicular nuclei, and are not flattened when seen on the surface of the epithelium during Stage 1 (Fig. 1). Later in the cycle they are seen in decreasing numbers in a more flattened form, and are probably degenerating. The nuclei become smaller and darker and the cytoplasm more dense. Some of them appear to be intermediate forms of "dense"cells that stain green, blue or gray, instead of red and are hard to differentiate.

Epithelial cells, Classes 5 and 6 are not recognized in the woodrat.

STAGES IN THE ESTROUS CYCLE

It would be desirable to use the names proestrum, estrus, metestrum and diestrum in designating the stages of the cycle, but it is hard to make accurate indications of the beginning and end of each of these standardized stages in the woodrat. They are not tame enough for the mating response, which can be elicited by hand in some laboratory rodents (Ball, '37; Blandau, Boling and Young, '41; Young, '37), nor would they mate while under observation. Thus, there was no convenient method of telling when physiological estrus occurred.

Four stages are based on the relative numbers of certain cell types in the vaginal smears. In woodrats sacrificed during each stage the ovarian condition is summarized and related to the vaginal sections and smears (Table I). One killed in early pregnancy is included in the descriptions. These stages can usually be followed in succession by taking smears once daily, but occasionally one of the shorter stages may be missed. A continuous series of smears, taken twice daily at 9 a. m. and 5 p. m. from July 10 to August 12, 1946, on woodrats No. 3, No. 6, and No. 8, are used as a basis for interpreting subsequent smears and for the following stages:

Stage 1

The vaginal smears (Figs. 2, 4, and 5) have "proestrous cells" (Type VI, Class 4) appearing in large numbers compared with the scanty smear of Stage 4. They usually constitute 30 to 60 per cent of those present. Various degenerating cells of Stage 4 are also found during the first part of the stage and vacuolated cells (Type IV, Class 2) and "dense" cells (Type VI, Class 1) appear later. Mucus is usually abundant.

This is the shortest stage, usually lasting 12 to 30 hours. When smears are taken once a day, the woodrats are seldom found to be in this stage for two days in a row, and it is sometimes missed.

The vaginal epithelium is thick during Stage 1, especially at the caudal part (Fig. 1). That region is lined with green staining "proestrous cells," where they can be seen desquamating into the lumen in large numbers. Leucocytes, many of which appear distorted, are distributed among the epithelial cells of that part of the vagina and can be seen infiltrating into the lumen.

The middle and cephalic parts of the vagina and cervix have columnar-shaped mucous cells forming the superficial layer of the epithelium (Fig. 3). The nuclei are dark, pyknotic and basilar in position and the cytoplasm stains red with muci-carmine.

There is usually much mucus in the lumen of the vagina for its entire length. With muci-carmine stain, red strands appear to be extending from the mucous cells toward the external orifice.

At the external orifice, cornified cells (Type I) can be seen desquamating in layers. Under the stratum corneum is a distinct stratum granulosum and a deeper stratum germinativum. These layers blend into the epithelium of the vagina proper. Near the point of junction can be seen flat, green cells on the surface, superficial to the cornified layer. This region at and near the orifice is apparently the source of the cells of the cornified series (Types I, II and III).

Ovulation occurs during stage 1. Of the three woodrats killed during this stage (Table 1), woodrat No. 7 has three large follicles which appear to be almost ready to ovulate and woodrats No. 10 and No. 20 had both recently ovulated.

Stage 2

Vaginal smear samples usually contain a large amount of cellular material. The vacuolated cells (Type IV, Class 2) are predominant in the smear during this time, making up 30 to 60 percent of those

present (Figs. 6 and 8). "Proestrous" cells (Type VI, Class 4) and "dense" cells (Type VI, Class 1) are also abundant early in the stage and "deep" cells (Type VI, Class 2) appear later.

The vagina has a medium thick epithelium. The caudal end has a uniform epithelium of green cells that show a little degeneration and flattening at the surface. At the middle and cephalic regions it is lined mostly with "dense" cells (Type VI, Class 1) with many of the "deep" cells (Type VI, Class 2) distributed among them. The epithelium of the cervix and that between the folds in some parts of the cephalic region have tall mucous cells persisting. "Deep" cells are also seen distributed among and deep to the mucous cells (Fig. 7).

The cytoplasm of the mucous cells appears to be stringing off with the mucus into the lumen, as if they are being used up by a process of holocrine secretion. Muci-carmine stains the cytoplasm and strands of mucus red. Vacuolated cells in the lumen are negative for mucin.

Leucocytes appear in relatively large numbers in the lumen, even though the epithelial cells are abundant. In addition to being infiltrated among the epithelial cells, they appear in lacunae along the surface, except at the cervix. Both green and red staining "deep" cells are also found in the lacunae and are seen to be located inside epithelial cells in the lumen, similar to the ones containing leucocytes.

Desquamation is going on in all parts except at the cervix, and is especially rapid in the middle and parts of the cephalic region.

Two woodrats (No. 2 and No. 21) were sacrificed during Stage 2 (Table I). Both have new corpora lutea and a corresponding number of eggs in the terminal portion of the oviducts, indicating that ovulation had occurred recently.

Stage 3

"Deep" cells that stain both red and green make up 40 to 70 percent of those present in the smears for one or two days of the cycle (Fig. 12). There are also "dense" cells and vacuolated cells present in large numbers, but the latter become fewer as the stage progresses. It is considered to be over when the vaginal sample becomes scarce or when the relative number of cells is greatly reduced.

The vaginal epithelium is thin in all areas (Figs. 10 and 11) except the caudal part, which is of medium thickness (Fig. 9). The latter region has a layer of flattened cells on the surface. Many leucocytes are infiltrated through the epithelium and into the lumen.

The middle part of the vagina appears to have lost most of the degenerating cells from the surface, with just a thin layer of dense flattened cells along the lumen (Fig. 10). The cephalic region and cervix are a little thicker and the "deep" cells are still present among the remaining flattened degenerating cells along the surface, but not forming a definite layer. A few areas of the cervix (Fig. 11) have some mucous cells left, but they appear to be mostly gone. These cells take a light pink color with muci-carmine, but the contents of the lumen are negative for mucin. The cephalic region and cervix appear to be the only areas where desquamation is abundant.

Some leucocytes can be seen among the degenerated cells on the surface and in lacunae there, but seldom deeper in the epithelium of the cephalic region and cervix.

Cells containing leucocytes (Type V) are seen among the superficial cells, but some of the larger lacunae open on the surface and release the leucocytes into the lumen. The "deep" cells also are in lacunae, alone or with leucocytes. The degenerating epithelial cells are mostly sloughed off by the time Stage 3 is ended.

Woodrat No. 11 was sacrificed during this stage (Table I). There are young corpora lutea with cavities and light blue luteal cells that probably represent the last ovulation, but no eggs can be found in the oviducts. The corpora lutea that are forming from follicles that have not ovulated appear to start developing later in the cycle. Three follicles in one of the ovaries seem to be earmarked for the next ovulation.

Stage 4

This is the interval of relative quiescence, or diestrum. There is usually a scanty smear obtained, containing pale, degenerated cells that are difficult to identify. When mucus is aspirated into the dropper the cells are usually trapped and obscured by the thick strands. The stage usually lasts one or two days, but may be much longer, as occurred in woodrats No. 6 and No. 22 before they were sacrificed (Table I). The smear does not vary much during a prolonged stage, but those two animals may not have a vaginal picture that is typical of stage 4.

In both of these woodrats there is a thin epithelium lined with flattened degenerated cells, most of which are hard to classify. Some are recognized as "dense," "deep" and mucous cells. The caudal region has a thicker epithelium which is lined with unflattened, undegenerated cells. The cervix has a thin epithelium similar to that of the cephalic and middle regions. Many leucocytes are infiltrated among the epithelial cells of the caudal part and a

few are seen in the layer of degenerating cells along the lumen of the rest of the vagina. There are not many cells in the lumen.

The few mucous cells remaining in and near the cervix are stained faintly with muci-carmine, but there is no mucus in the lumen.

Woodrat No. 6 had remained in Stage 4 for five days. The absence of any large follicles that might soon ovulate would indicate that it may have continued for a while longer before a new cycle would begin. Three sets of corpora lutea would seem to indicate that previous cycles had taken place normally.

Woodrat No. 22 had been in this stage for 21 days before death. The complete absence of corpora lutea and large follicles are further evidence that the cycle was arrested and abnormal. The wood rat had been losing weight and appeared to be sick.

Early Pregnancy

Woodrat No. 17 was captured March 19, 1947, and sacrificed the same day, immediately after taking a vaginal smear. There are three embryos less than 1 mm. long in the left horn and one in the right horn of the uterus.

The vaginal smear has a mixture of the usual cells seen during Stage 3 of the estrous cycle; and some green oval cells with pyknotic nuclei are also abundant. These cells are different from any of the cell types of the normal cycle, being larger than the "deep" cells and having small, dark, round nuclei.

The vaginal epithelium is of medium thickness in general, with considerable variation at different areas. The anterior half, including the cervix, is lined with columnar-shaped mucous cells and some red and green staining "deep" cells mixed in among them. The mucous cells stain red with muci-carmine. The rest of the epithelium has a more or less flattened layer of "dense" cells, the cells with round pyknotic nuclei like the ones in the smear, and "deep" cells distributed among them. There appears to be more desquamation and leucocytic infiltration in the posterior part. Some mucus and a few cells are seen in the lumen.

The ovaries are of about the same size as those of non pregnant woodrats. There are many growing and atretic follicles under 0.8 mm. in diameter and no eggs in the oviducts. One ovary has one large corpus luteum with pale lutein cells that have fibrocytes between them. The other ovary has three large corpora lutea similar to the one in the first.

REPRODUCTIVE FUNCTION UNDER DIFFERENT CONDITIONS

Since the woodrat does not have a true cornified cell stage, it is not surprising that Donat ('33) and Wood ('35) failed to recognize cyclic changes with a few smears. There is a possibility of species differences, however.

They suggest that the cycle might be different while the animals are kept in captivity. We have some evidence to indicate that the woodrats have cycles under natural conditions similar to those in captivity, especially during the spring and summer. Woodrat No. 13, which was kept in the large outdoor cage that was constructed to simulate natural conditions, was found to show a smear cycle of four or five days during March and April, and a cellular sequence like the woodrats kept in small cages. Woodrat No. 21 was caught in one of the live traps in the morning, March 30, 1947, and daily smears were begun that afternoon. She was in Stage 2 that day, continued through the rest of the cycle in about the usual way, and reached Stage 1 of the next cycle on the fifth day after being captured. The next two cycles were both 6 days long, indication that the one in progress when the woodrat was captured corresponded very closely to those that followed.

DISCUSSION

Considering proestrum to be the period of growth of the reproductive tissues in preparation for heat, or estrus, cetestrum to be the degenerating and sloughing off period, and diestrum to be the period of quiescense; we can correlate the stages of the woodrat to this scheme to a certain extent.

Physiological estrus probably occurs at the time of ovulation, as in other rodents, and that includes at least the latter part of Stage 1. Proestrum is apparently the first part of Stage 1 and is very short, unless growth starts in the vaginal epithelium late in Stage 4 as in Woodrat No. 22 (Table I). Physiological estrus may extend into Stage 2, which corresponds to the cornified cells stage of some rodents, except that vacuolated cells appear instead. Stages 2 and 3 correspond to metestrum of other rodents, in that the thickness of the vagina becomes much reduced (Table I). Stage 4 is a period of quiescence and fits well into the description of diestrum.

The vacuolated cells are not recognized in the epithelium without special stains and it is difficult to tell where they come from. The fact that that they are negative for mucin indicates that they, like the other cell types seen in the smears and lumen, are sloughed off

where there is no superficial layer of mucous cells. They have begun to appear in the smears at the time of ovulation, during Stage 1, and the desquamation probably takes place later than the formation of a particular cell type. That would place the vacuolated cell formation approximately during ovulation and heat, and corresponds to cornification in most other rodents. Drying of smears causes the epithelial cells to lose their true appearance (Papanicolaou, '33 and Hartman, '44), and causes vacuoles to be masked. Some workers may not have recognized them because of inferior methods of fixation.

Selle ('22) describes vacuolated cells during his Stage 1 of the guinea pig cycle, both in the smears and forming a superficial layer for the whole length of the vagina. He apparently did not use a specific test for mucin, and it is hard to tell if he had mucous cells or vacuolated cells, or both. The cornified layer was seen to form deep to the superficial layer of "vacuolated cells", and the latter would be removed when the cornified cells sloughed off in layers. He describes a comparatively sudden end to his Stage 1, as the cornified cells started sloughing off abruptly. Without a cornified layer forming beneath the superficial mucous layer in the woodrat, the latter layer persists in the cephalic part of the vagina, and desquamation does not take place over the entire vagina at once until late in Stage 3. That and the lack of layer formation of desquamating cells, accounts for the mixture of more than one cell type in smears.

Cole ('30) found cornification in the vestibule, but not in the vagina proper of the cow. He also describes a superficial layer of tall, columnar, mucus-secreting cells during proestrum. As the cycle progressed the layer became reduced in height and the whole epithelium became thinner in some unknown way, but not by desquamation. The superficial layer of mucous cells is not sloughed off in the woodrat, but appears to be used up in the process of secretion. Cole (30, Fig. 13) also describes a "vacuolar degeneration" deeper in the vagina, which resembles the vacuoles seen in the part of the vagina of Woodrat No. 26 which was fixed in alcohol.

Wilson ('26) also describes a superficial layer in the vagina of the sow with "vacuolar degeneration", and no cornification. Stains for fat or mucin may be helpful in correlating the cellular changes in some of these animals.

Hartman ('44) found the "mucous cells" to occur in the vaginal smears from the rat during the third day of the cycle, which is two days after the "scales" dominate the smear. He also found phago-

sytized cells and some deep cells in the smear at that time. They seem to occur later in the cycle than the time when vacuolated cells are first found in smears from woodrats. The time relationship of the woodrat fits that of the castrated rats he injected daily with 0.005 mg. of estradiol dipropionate. Two days after injections were started there were small green "mucous cells" present in the smear in large numbers, and on the next day there were only scales, cornified cells and "shorr" cells present. He considers these small green vacuolated cells to be different from the "mucous cells" that occur in the natural cycle on the third day. Most of the vacuolated cells in the smears from woodrats are green, especially the ones appearing early in the cycle. Mucification and vacuolation occur at about the same time in the woodrat, and the hormones mediating one process may also effect the other.

Even though the vacuolated cells in the smears are negative for fat with both osmic acid and Sudan IV, it seems possible that the vacuoles contain fat that is not colored by the dyes after being sloughed off into the lumen. The frozen sections of the vagina from woodrat No. 26 show only relatively small fat droplets in the epithelium that are colored with Sudan IV. The part fixed in alcohol shows large vacuoles, which are of about the same size as most of the ones in the vacuolated cells of smears.

The color difference between the two kinds of "deep" cells is striking and probably significant, but we do not know why some are pale green (pink with H & E) and the others are red-orange (dark red with H & E). Both kinds appear in the vaginal epithelium and smears during late Stage 2, become abundant during Stage 3 and persist in small numbers in the first part of Stage 4. Since they are distributed among the other cell types, without forming a layer, their development appears to be related to the time of the cycle more than their position in the epithelium. There seems to be a "selective degeneration" in the epithelium. We also wonder how they get inside other epithelial cells, where they are seen frequently in the lumen and smears. Wilson ('26) describes vacuoles in the vaginal epithelium of the sow which contain "remnants of degenerating cells" and occasional leucocytes during the first week of estrus.

The caudal part of the vagina proper, except the external orifice, has epithelial changes that are different from those of other regions. The "proestrous" cells are desquamated from that region during Stage 1 and it is probably the source of vacuolated cells during that stage. Mucous cells or "deep" cells are not seen there at any

time, and the amount of desquamation is much reduced in that area by Stage 2. Leucocytes may be seen infiltrating through the epithelium at any time of the cycle, and it appears to be the only source of them during Stages I and II. Late in Stage II and during the rest of the cycle the leucocytes are also seen infiltrating and in lacunae in the epithelium of the rest of the vagina proper.

Shorr ('40) considers the trichrome stain to be a very sensitive indicator of the degree of cornification, by staining the cells progressively greener, then suddenly red-orange as the estrogen level is raised. That does not apply to cells of the "oval series" in the woodrat, and most of the cells of the vagina belong in that group. The red staining of some of the major types of cells is a common feature of the degeneration process, yet it is doubtful if it is a cornification. There are no signs of basophilic cells as precursors of these cells, as has been described deep to the stratum corneum by Long and Evans ('22) and Selle ('22), and as seen at the external orifice of the vagina in the woodrat.

These and other questions concerning changes in the vaginal epithelium may be answered in the future with specific stains and histochemical procedures. This animal might also lend itself to endocrine research, in an effort to learn if hormones cause such processes as vacuolation and mucification.

SUMMARY AND CONCLUSIONS

Vaginal smears have been made from thirteen adult female woodrats. Nine were sacrificed and the microscopic structure of the vaginas and ovaries described. Eight of them were killed at known stages of the cycle and one was in early pregnancy.

Cornification does not occur in the vaginal epithelium at any time during the cycle, except at the external orifice. Longitudinal sections of the vagina and cervix show regional variations in the epithelium and contents of the lumen. Leucocytes are always present in the smears, and variations in their number are not found to occur consistently during the cycle.

The cell types in the vaginal smears are described and some of them are used as indicators of four stages in the estrous cycle, and correlated with the vaginal epithelium and ovaries of woodrats sacrificed:

Stage 1 corresponds to the "proestrous" cells stage of other rodents, but the vaginal epithelium has a superficial layer of columnar mucous cells and ovulation takes place during that period.

Stage 2 has vacuolated cells predominant in the thick smear,

desquamation at the caudal and middle regions of the vagina and corpora lutea forming from recently ovulated follicles in the ovary.

Stage 3 smear is still thick and contains many cells, mostly small round ones from deeper in the epithelium and desquamation is taking place along the whole length of the vagina.

Stage 4 has a scanty smear, containing a few degenerated epithelial cells and varying amounts of mucus. The corpora lutea continue to grow and the lutein cells appear lighter.

While in captivity the woodrat has year round spontaneous estrous cycles of three to eight days. Most of them last four to six days. Vaginal smears during March and April from one female kept in a large outdoor cage also show regular cycles during those two months.

The woodrat sacrificed during early pregnancy has a vaginal epithelium similar to Stage three of the estrous cycle.

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TABLE I.—Summary of the woodrats killed during various stages of the estrous cycle

Woodrat number	Smear at death	The vaginal epithelium				Ovaries					
		Relative thickness	Caudal part	Cephalic and middle	Cervix	Follicles over 0.8 mm.		Corpora lutea		Eggs in oviducts	
						Ovary A	Ovary B	Ovary A	Ovary B	Ovary A	Ovary B
7	Stage 1	++++	proestrous cells	mucous cells	mucous cells	3 atretic, 1 not atretic	2 atretic, 2 not atretic	3 sets, newest with pale lutein cells	3 sets, newest with pale lutein cells	none	none
20	Stage 1	+++	proestrous cells	degenerated and mucous cells	mucous cells	none	1 atretic with lutein cells on side	4 sets, newest with blue lutein cells and c. t. centers	4 or 5 sets, newest has 3 with collapsed cavities	none	3 in terminal part
10	Stage 1	++++	proestrous cells	mucous cells	mucous cells	none	1 in early atresia	4 sets, newest with pale lutein cells	4 sets, newest with 3 having collapsed cavities	none	3 in terminal part
2	Stage 2	+++	proestrous and dense cells	dense and deep cells mostly	mucous cells	none	2 atretic with lutein cells on side	4 sets,* newest has 1 with med. sized cavity	4 or 5 sets, newest has 1 with med. sized cavity	1 degenerating in the middle part	1 degenerating in the middle part
21	Stage 2	+++	proestrous and dense cells	deep and dense cells	mucous and deep cells	1 in early atresia and egg with polar body	none	4 or 5 sets, newest has 2 with med. sized cavities	4 sets, newest has 1 with blue cells and c. t. centers†	2 degenerating in the middle part	none

TABLE I.—Summary of woodrats killed during various stages of the estrous cycle—CONCLUDED

Woodrat number	Smear at death	The vaginal epithelium				Ovaries					
		Relative thickness	Caudal part	Cephalic and middle	Cervix	Follicles over 0.8 mm.		Corpora lutea		Eggs in oviducts	
						Ovary A	Ovary B	Ovary A	Ovary B	Ovary A	Ovary B
11	Stage 3	++	dense cells	deep and dense cells	deep, dense and mucous cells	none	3 not atretic	4 sets,* newest with pale blue cells and c. t. centers	4 or 5 sets,† newest with pale blue cells and c. t. centers	none	none
6	Stage 4	+	dense cells	degenerated dense and deep cells	dense and deep cells	none	none	3 sets, newest with pale cells	3 sets, newest with pale cells	none	none
22	Prolonged stage 4	++	Proestrous and dense cells	degenerated, dense and deep cells	degenerated, dense and deep cells	none	none	none	none	none	none

* An additional corpus luteum appears to be forming from a follicle that has not ovulated A degenerating egg, with the first polar body formed, is seen inside of the cavity.

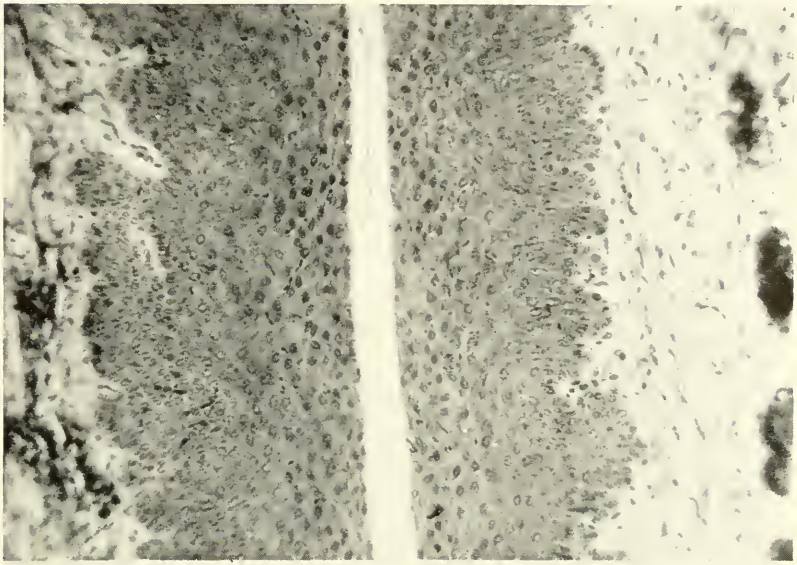
† Two additional corpora lutea are forming from follicles that have not ovulated. Degenerating mitotic eggs are seen in the large cavities.

PLATE XXIX

FIG. 1. Vaginal epithelium during Stage 1, Woodrat #7; a longitudinal section at the posterior end. × 300. The epithelium is thick and appears to have very little degeneration. Leucocytes, some of which are distorted, are infiltrated among the epithelium cells.

FIG. 2. Vaginal smear of Stage 1, Woodrat #7, the last one before death. × 300. Showing a mixture of cells of different types. Arrows indicate some of the cell types: (a) cornified cell and (b) "precornified" cell, which come from the external orifice of the vagina; (c) "proestrous" cells and (d) dense cells.

PLATE XXIX



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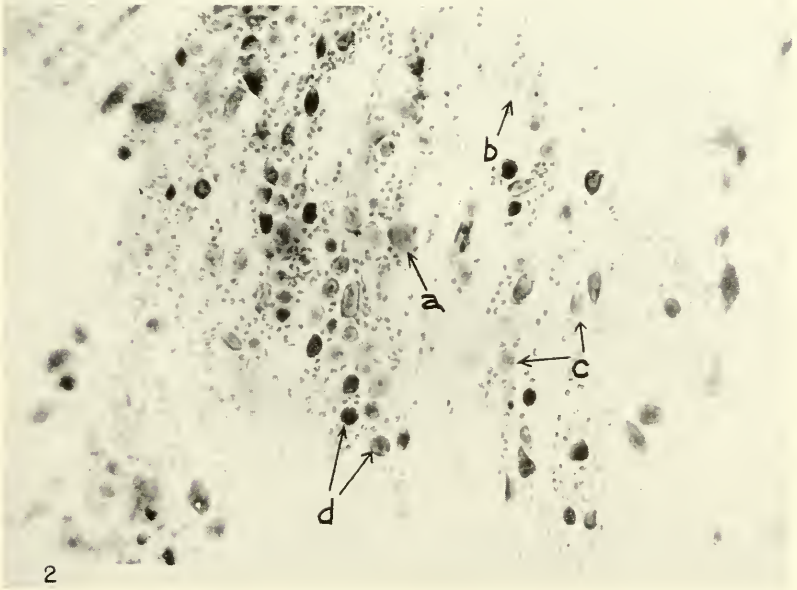

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PLATE XXX

FIG. 3. Vaginal epithelium of Stage 1, Woodrat #10. × 300. A longitudinal section showing the epithelium on both sides of the lumen in an area of dehiscence between the caudal and middle regions of the vagina. Tall columnar mucous cells line the lumen on the right and some low mucous cells persist on the left, where "proestrous" cells and leucocytes are sloughing off.

FIG. 4. Vaginal smear of Stage 1, Woodrat #7, the last one before death. × 300. "Proestrous" cells are numerous, but pale staining (a). Many "deep" cells have persisted from the previous stage and appear small and dark. (b) A "phagocytized" cell.

PLATE XXX

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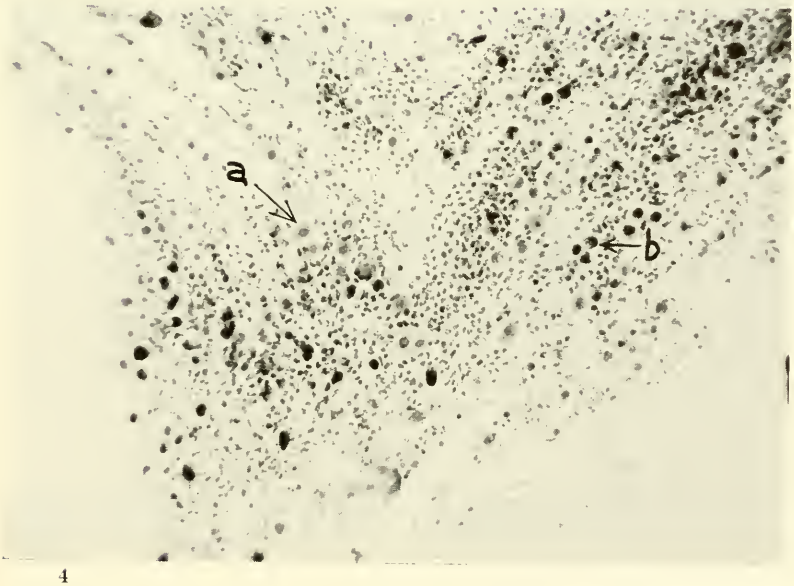

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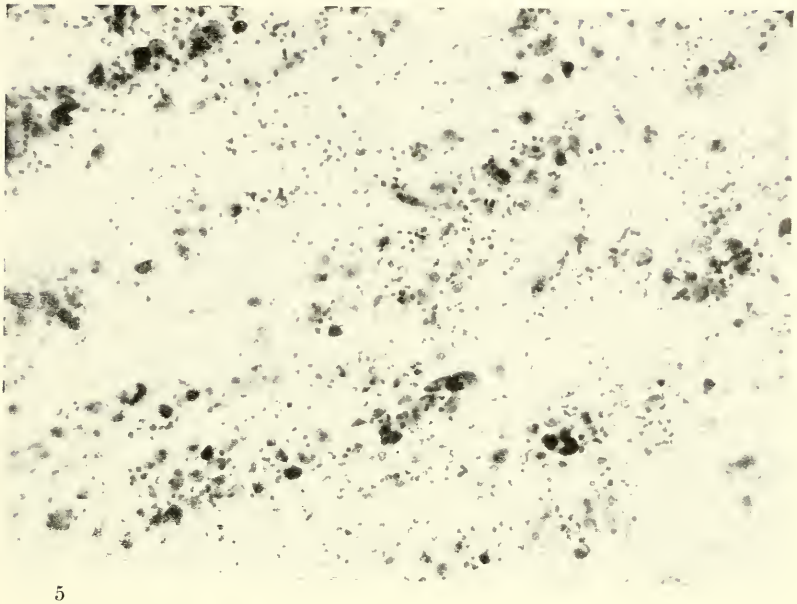
PLATE XXXI

FIG. 5. Vaginal smear of Stage 1, Woodrat #20, taken just before death. × 300. Most of the "proestrous" cells are pale and difficult to see. Some vacuolated cells are present, a few in the center of the field have several small vacuoles in the cytoplasm.

FIG. 6. Vaginal smear of Stage 2, Woodrat #2, taken just before death. × 300. Vacuolated cells are numerous, with some "deep" cells and a few "proestrous" cells persisting from the previous stage. The larger dark cells are the "dense" cells, (a) one which has the appearance of a flocculate in the cytoplasm.

PLATE XXXI



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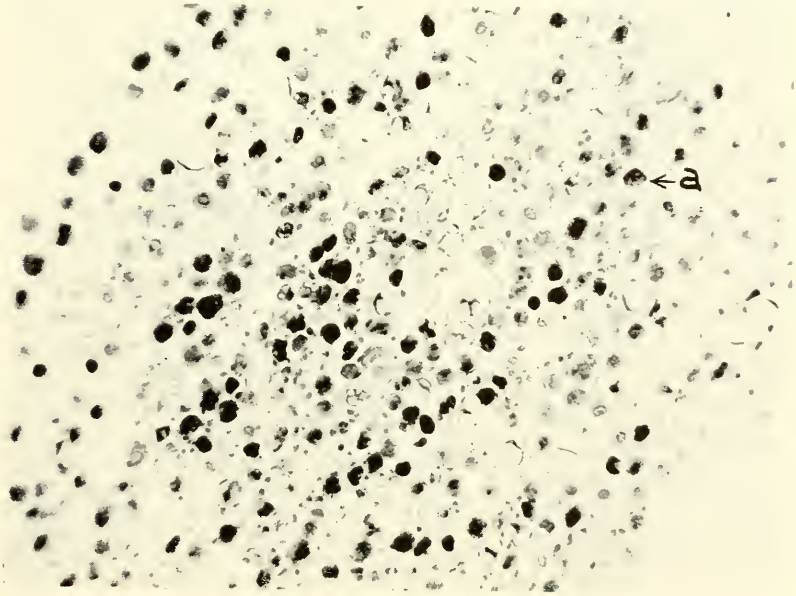

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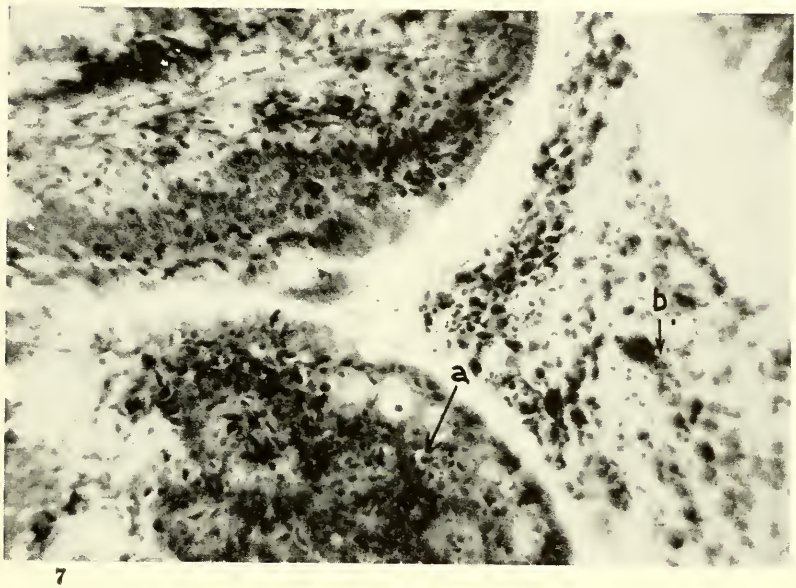
PLATE XXXII

FIG. 7. Vaginal epithelium of Stage 2, Woodrat #21. × 300. Longitudinal section with a transverse fold, at the central region of the vagina. Many epithelial cells and leucocytes are seen in the lumen. Some mucous cells are persisting in the fold. Lacunae in the epithelium contain leucocytes and "deep" cells. (a) A "deep" cell in one of the smaller lacunae; (b) a "deep" cell inside another epithelial cell in the lumen.

FIG. 8. Vaginal smear of late Stage 2, Woodrat #21, the last one before death. × 300. "Deep" cells and vacuolated cells are most abundant. (a) An epithelial cell containing two "deep" cells.

PLATE XXXII



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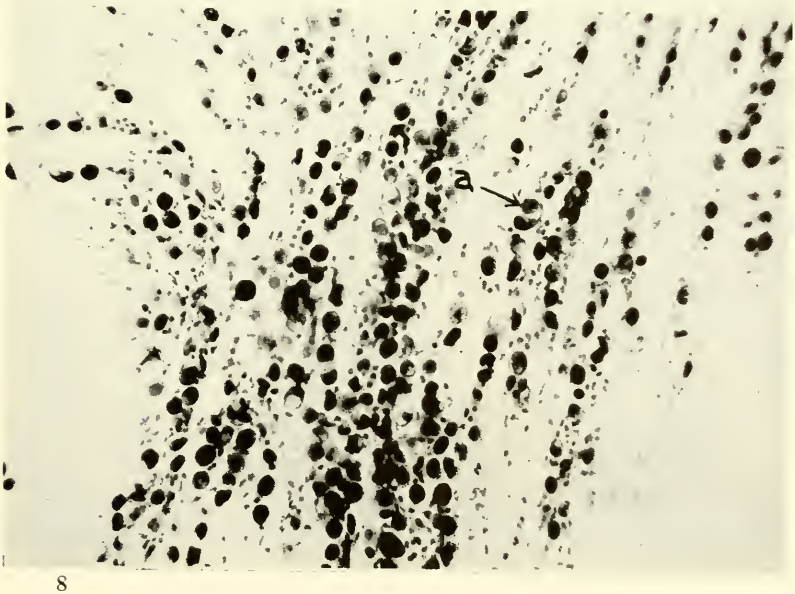

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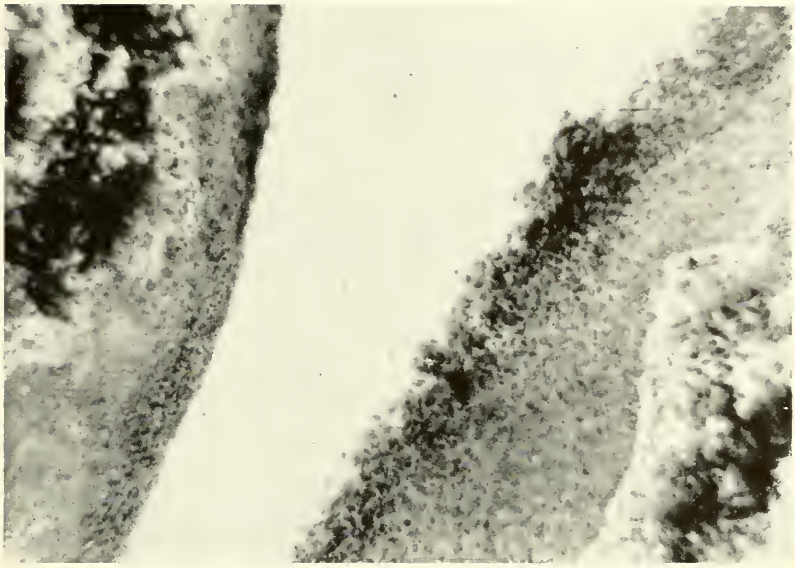
PLATE XXXIII

FIG. 9. Stage 3, Woodrat #11. Longitudinal section of the vaginal epithelium near the external orifice. ×300. The epithelium is still quite thick in that area, and large numbers of leucocytes are infiltrated through it and into the lumen. The transitional zone between the vaginal epithelium and the cornified layer of the external orifice is seen at the left.

FIG. 10. Stage 3, Woodrat #11. Longitudinal section of the epithelium in the central region of the vagina. ×300. The epithelium is very thin, lined with "dense" cells and a few "deep" cells among them. (a) A "deep" cell in a lacuna.

PLATE XXXIII



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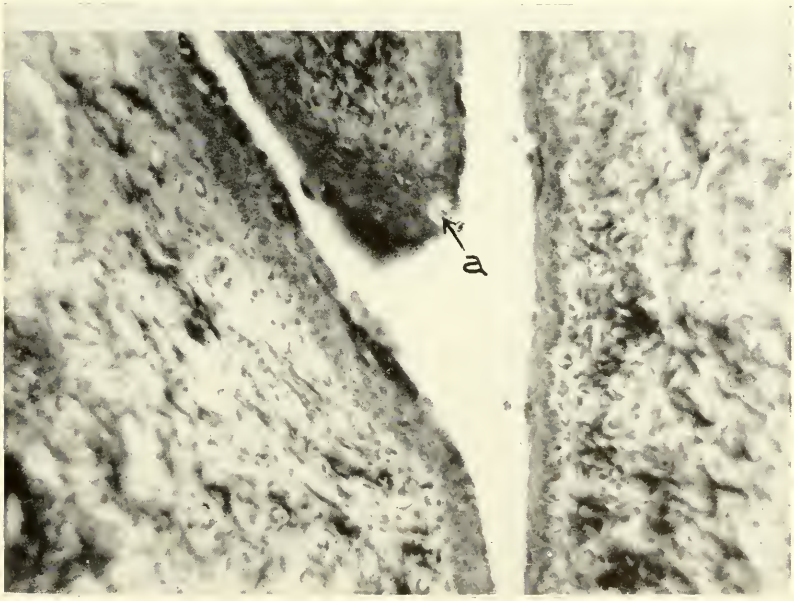

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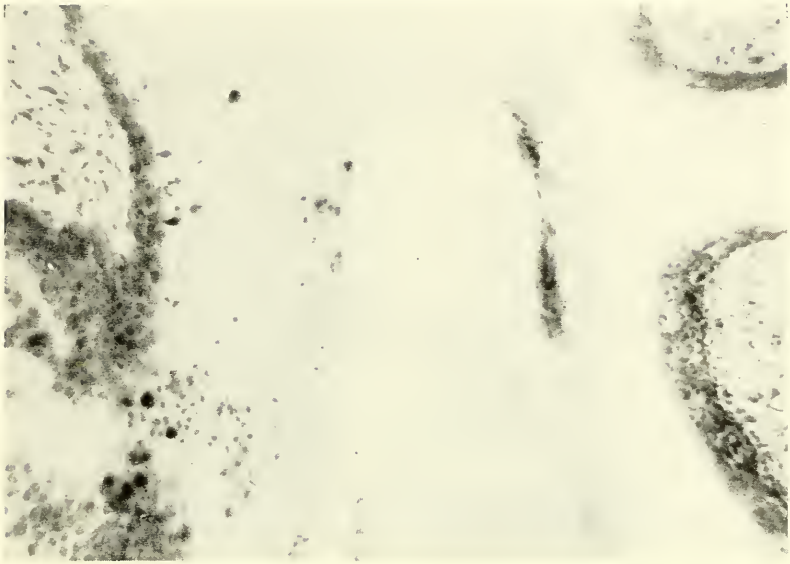
PLATE XXXIV

FIG. 11. Stage 3, Woodrat #11. Longitudinal section of the epithelium at the cervix. ×300. The epithelium is thin. Some mucous cells can still be seen, especially in the folds, but the surface of the epithelium is mostly "dense" cells and some "deep" cells distributed among them.

FIG. 12. Stage 3, Woodrat #11. Vaginal smear. ×300. "Deep" cells make up most of the epithelial elements in the field. (a) A "phagocytized" cell, which contains one leucocyte.

PLATE XXXIV



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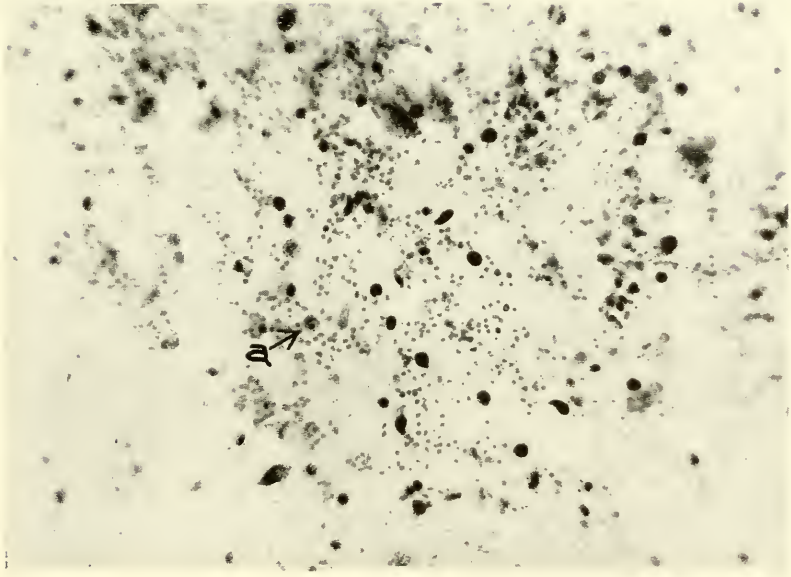

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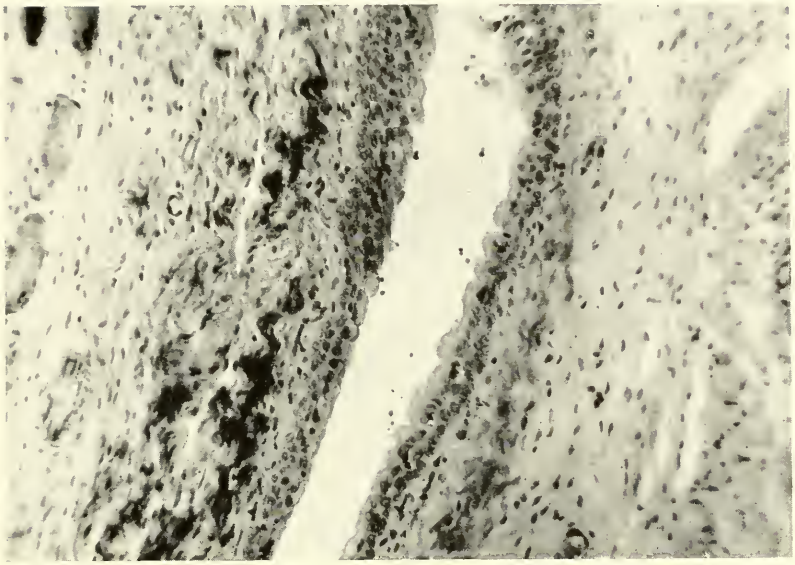
PLATE XXXV

FIG. 13. Stage 4, Woodrat #22. Longitudinal section of the vagina in the central region. ×300. The epithelium is thin and shows little evidence of either growth or desquamation.

FIG. 14. Stage 4, Woodrat #22. Vaginal smear taken just before death. ×300. Leucocytes and degenerated epithelial cells are trapped in the strands of mucous.

PLATE XXXV



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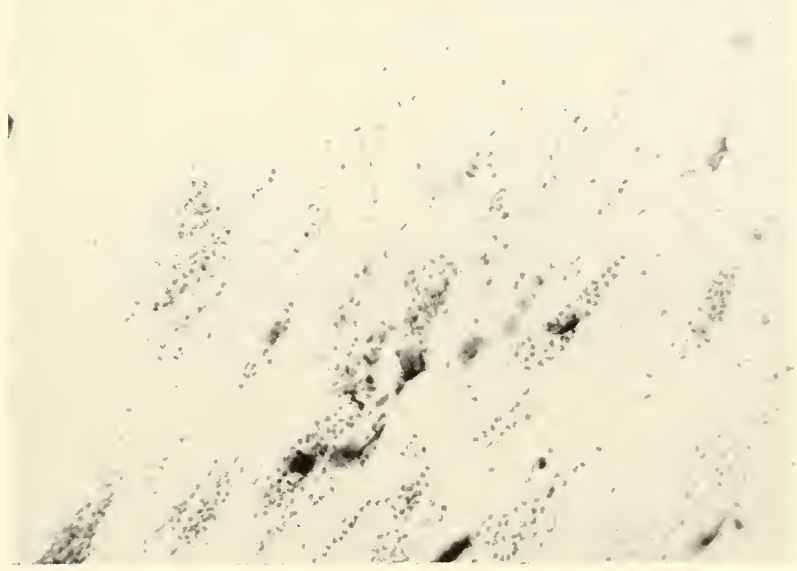

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A Revision of the Genus Anisops * (Notonectidae, Hemiptera)

BY

GEORGE T. BROOKS †

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* Submitted to the Department of Entomology and the Faculty of the Graduate School of the University of Kansas in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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ABSTRACT: This paper constitutes a revision of the genus *Anisops* of the family Notonectidae, Hemiptera. Though it is primarily taxonomic, material on the biology of genus is included.

Prior to this work sixty-four species and two subspecies were known. Thirty-one new species are described in this paper. Two color forms are raised to specific level and two species are taken out of synonomy and placed again on specific level. Four species are placed into synonomy.

The subgeneric designations as established by Hutchinson in 1929 are omitted as no evidence was found to support their validity.

The new species are: *A. campbelli* (India), *A. elstoni* (Australia), *A. paracrinita* (Australia), *A. hackeri* (Australia), *A. nodulata* (Philippine Isls.), *A. timorensis* (Timor), *A. coutierei* (Djibouti, Africa), *A. malkini* (Australia), *A. evansi* (Tasmania), *A. sikoroensis* (Madagascar), *A. fijiensis* (Fiji Islands), *A. semita* (Australia), *A. canaliculata* (Australia), *A. tasmaniaensis* (Tasmania), *A. lipovskyi* (India), *A. deanei* (Australia), *A. philippinensis* (Philippine Isls.), *A. barbata* (India, Java), *A. tanalensis* (Madagascar), *A. windi* (Australia), *A. barrenensis* (Australia), *A. paranigrolineata* (India), *A. cavifrons* (India), *A. extendofrons* (India), *A. graciloides* (South Africa), *A. kempi* (India, Burma, Siam), *A. crinita* (Corfu, India, New Caledonia), *A. majiensis* (Maji-Chumvi, Africa), *A. biroi* (New Guinea), *A. rigoensis* (New Guinea), and *A. waltairensis* (Australia).

Up to and including this paper (exclusive of the synonyms) there have been described ninety-four species and two subspecies.

ACKNOWLEDGMENTS

I wish to express my gratitude to all who have assisted me in the preparation of this paper. I am deeply indebted to Dr. H. B. Hungerford, who suggested this study and without whose careful guidance its completion would not have been possible. To Dr. R. H. Beamer, Dr. K. C. Doering, and Dr. C. D. Michener I extend my sincere thanks for the advice and constructive criticism they so willingly gave. I highly appreciate the help given me by the departmental artists in the preparation of my plates.

INTRODUCTION

This paper is a taxonomic study of the genus *Anisops* (Notonectidae, Hemiptera), designed to alleviate many of the problems which have originated through poor descriptions and inaccurate determinations. It covers ninety-six species, thirty of which are new. In addition to having material from the Francis Huntington Snow Collection, a vast amount of material from other museums was placed at my disposal. The Museums, which made their material available to me, are as follows: British Museum, Paris Museum, Royal Museum of Natural History of Belgium, Basel Natural History Museum of Switzerland, Indian Museum at Calcutta, United

States National Museum, Harvard Museum of Comparative Zoology, and the Chicago Natural History Museum. In addition, I have studied material from the collections of Lutz, Usinger, California Academy of Science, and the Department of Agriculture, Sydney, New South Wales, Australia. To each of these I wish to express my gratitude for without their cooperation, this study would have been impossible.

REVIEW OF THE LITERATURE

In 1840, Spinola (38) established the genus *Anisops*. Franz X. Fieber (11) in 1851, redescribed the genus and all known species belonging thereto. During the next half-century many species were described; some were valid, others not, for unfortunately it was the practice of the taxonomists of that time to describe and determine species largely on the basis of color. This resulted in much confusion not only in regard to the accuracy of determination but also in ascertaining the possible geographical distribution of a species.

In 1904, Kirkaldy (30) published his "Über Notonectiden." In this paper three important changes were made. First, he examined types when possible and indicated synonymous species. Second, he introduced the use of structural characteristics in species determination. Third, he divided the genus into two genera. The generic name *Buenoa* was proposed for those species inhabiting the Western Hemisphere; the name *Anisops* was retained for the species of the Eastern Hemisphere. However, this separation was not made on geographical distribution alone, but on the fact that the males of the species of the Western Hemisphere all have two-segmented front tarsi (the third is present, but so small as not to be readily discernible) while the males of the species of the Eastern Hemisphere have one-segmented front tarsi.

In 1923, H. M. Hale (14) published "Some Aquatic Hemiptera from Western Australia" which included descriptions of the species of that area along with a key. In 1929, G. E. Hutchinson (23) published "A Revision of the Notonectidae and Corixidae of South Africa." In this publication keys and descriptions for species of that area were provided. Lundblad (32) in 1933 published "Zur Kenntnis der Aquatilen und Semi-Aquatilen Hemipteren von Sumatra, Java, and Bali," in which many of the species of that area were described adequately for the first time. Though each of these above mentioned papers is extremely valuable, together they accounted for only about half of the species known in 1933.

Through the years two problems have consistently plagued the workers in this genus. First, most of the older descriptions were based on color and it is almost impossible to determine species on this basis. Second, the finding of suitable characters to separate the species has been particularly difficult. As has been pointed out by previous workers, notably Lundblad (32) and Hutchinson (23), only the males can be relied on for accurate determination. Unfortunately, the male genital capsule is not of specific value in this genus and other characters for separation of the species must be found.

Jaczewski (28) noted that the shape of the eyes together with that of the vertex appeared to be of specific importance as well as the shape and size of the rostral prong. Poisson in many of his descriptions has made extensive use of the chaetotaxy of the male front legs and Hutchinson (23) has indicated the specific value of the facial tubercle. Lundblad (32) made use of all these characters in his specific descriptions.

After examining many species, I find the above characters together with the shape of the labrum and front femur of the males afford a ready means of species determination.

This paper represents the first generic revision since Kirkaldy's paper of 1904. I have tried to account for every named species, but in some cases the descriptions were based on females and it is impossible to assign a species to such a description, as females of different species are often almost identical; in other instances the material available yielded no specimens which matched the descriptions.

I was extremely fortunate in having at my disposal many specimens, which were compared with types by D. H. B. Hungerford in 1928. This has been extremely valuable, especially in cases of unavailable types and poor descriptions.

THE FAMILY NOTONECTIDAE

The family Notonectidae includes those truly aquatic forms which differ from all others, except Pleidae and Helotrephidae, in the constant habit of swimming on their backs. The members of this family are deep-bodied, flat ventrally, and convex dorsally. The eyes are large reniform, and twice sinuate, occupying most of the dorsal surface of the head. Ocelli are absent. The antennae arise on the latero-ventral surface of the head, immediately posterior to the eyes; each antenna consisting of three or four segments. Beak four-segmented. Front and middle pairs of legs adapted for grasp-

ing, hind legs for swimming. Tarsi (except the one-segmented fore tarsi of the male *Anisops*) three-segmented counting a small basal segment which is inconspicuous. Tarsi possessing two apical claws which may be greatly reduced on the hind pair of legs. Ventral abdominal segments with median longitudinal keel, which has hairs, at least on its lateral margin. Sides of the venter with hairs directed medianly.

This family consists of eight genera which may be separated by the following key as advanced by Hungerford (22).*

KEY TO GENERA OF THE NOTONECTIDAE

A. Hemelytral commissure without definite hair-lined pit at anterior end (Subfamily Notonectinae)
  B. Intermediate femur with anteapical pointed protuberance and antennae 4-segmented .....(Tribe Notonectini)
    C. Anterolateral margins of prothorax not foveate.....*Notonecta*
    CC. Anterolateral margins of the prothorax foveate.....*Enithares*
  BB. Intermediate femur without anteapical pointed protuberance. Antennae 3- or 4-segmented.....(Tribe Nychini)
    C. Intermediate tarsus with two well-developed segments and a very small basal one. Sides of prothorax not foveate. Infra-coxal plates bare, but margined with hair.....*Neonychia*
    CC. Intermediate tarsus with one well-developed segment. Infra-coxal plates covered with hair.
      D. Antennae three segmented.....*Nychia*
      DD. Antennae four segmented.....*Martarega*
AA. Hemelytral commissure with definite hair-lined pit at anterior end (Subfamily Anisopinae)
  B. Ventral abdominal keel not extending onto last abdominal segment. Male genital capsule cleft behind. Males without stridular protuberance on front tibia. Females with short gonapophyses.....*Paranisops*
  BB. Ventral abdominal segment extending onto last abdominal segment.
    C. Male with anterior tarsus 2-segmented.....*Buenoa*
    CC. Male with anterior tarsus 1-segmented.....*Anisops*

THE GENUS ANISOPS

The genus *Anisops* is readily distinguishable from all other genera in the family by the following three combination of characters: the presence of a pit at the anterior end of the hemelytral commissure, the extension of the ventral abdominal keel onto the last abdominal segment, and the one-segmented front tarsi of the males.

The members of this genus are slender insects and usually small, though some species attain a length of about 12 mm. The eyes are large and not holoptic (except *A. breddeni* Kirkaldy and *A. kempi* n. sp.). The anterior half of the dorsal interocular space has a median longitudinal depression between two slightly swollen areas. The back is convex longitudinally with the thorax being deeper than the other parts of the body. The hemelytra are not coriaceous

* Later modified to include the genus *Paranychia*. Still later changed to *Neonychia* (see Journ. Kansas Ent. Soc., vol. XXIII, p. 73, 1950).

as in *Notonecta* and *Enithares* and there is little difference in the texture of the membrane and the remainder of the wing though the two areas are definitely delimited. The underside of the abdomen has a median longitudinal keel whose lateral margins bear long hairs. On either side of the abdomen next to the connexivum is a longitudinal trough. The inner margins of the connexivum bear long hairs which together with those of the keel serve to trap air in the trough. All the tarsi are two-segmented with the exception of the male front tarsi which are one-segmented.

Only the males possess a stridulatory apparatus, which consists of a tibial comb and a rostral prong (to be described in detail later). The claspers of the genital capsule are asymetrical and of uniform shape for the genus, the right one being broad, while the left is deeply excavate on the posterior margin and hook-shaped at the apex. (Plate XXXVI figs. 3, 4.)

An interesting feature of the internal anatomy of both males and females is the presence of two ventral rows of cells containing hemoglobin (35). Each row is divided into distinct groups corresponding in number to the abdominal spiracles and attached to the latter by the tracheal trunk. These cells are tracheal cells, around and in which the tracheoles ramify. A similar group of cells have been observed by Bare (2) in the genus *Buenoa*.

SYSTEMATICS OF THE GENUS ANISOPS

Hutchinson in 1929 divided the genus into three subgenera, namely *Microanisops, Anisopoides,* and *Anisops.* The first two are monotypic.

The subgenus *Microanisops* was erected on the following characters: brachypterous wings and elytra, a short posterior tarsus with the tibia being one and three-fourths the length of the latter, and the presence of a subapical black spot on the hemelytra. The subgeneric type is *Anisops (M.) apicalis* Stål. In a study of a male and female of this species determined by myself, I do not find the hemelytra to be brachypterous, but extending the full length of the body; however the wings are reduced and appear non-functional. Moreover, the posterior tibia is not one and three-fourths the length of the posterior tarsi but only one and two-sevenths, a relationship also found by Jaczewski (23). *Anisops (M.) apicalis* is not unique in having the subapical black spot as I have observed similar spots on specimens of *A. (A.) ares* Hutchinson. The single good character for such a group would be the brachypterous wings. However, *Anisops (Anisops) hungerfordi* Poisson which occurs in central

Africa along with *Anisops (M.) apicalis,* is so closely related to this species that they may be forms of the same species. They differ primarily in the character of the scutellum which is greatly reduced in size in *Anisops (M.) apicalis,* a condition which is to be expected in brachypterous forms. Also, the wings of the *Anisops (A.) hungerfordi* are not brachypterous. A closer investigation of the biology of the two species would be necessary before determining whether or not they are forms of the same species.

The type of the subgenus *Anisopoides* is *Anisops (Anisopoides) agalia* Hutchinson and the subgenus is based on the lack of rostral prongs. The presence of the stridulatory comb on the tibia suggests that this species arose from forms having rostral prongs and which have been lost through specialization.

In my study of the genus, I have found no forms to add to either of the subgenera of Hutchinson. Both subgenera appear to be only individual specializations and not worthy of subgeneric designation. Therefore, I have chosen not to use the subgeneric groups as established by Hutchinson as I do not believe such to be valid.

The term "form" has been used by previous workers to describe specimens having a different color pattern from that of the type of the species. Only in two cases, *A. sardea* f. *madagascarensis* Poisson and *A. pellucens* f. *grandis* Poisson are such differences supported by morphological differences. In both of these cases I have raised the so-called "forms" to species level. Otherwise, I have disregarded the "form" as a subspecific designation.

PHYLOGENY

The species of *Anisops* exhibit many specializations. Most of them do not indicate phyletic tendencies as they occur, oftentimes, in completely unrelated forms.

The only specialization that appears to indicate a phyletic line is an increase in the size of the eyes. On the basis of this character, the species of the genus fall in one of two groups. In one the enlargement of the eyes is accompanied by a subsequent narrowing of the interocular space from the synthlipsis forward. The peak of this series is reached in *A. breddeni* Kirkaldy and in *A. kempi* n. sp., both of which have holoptic eyes. This group embraces the majority of the species. Within this group there is a small discrete unit of eight species, so closely allied to one another and representing such a unique line of specialization as to be worthy of note. This small group is characterized by males possessing an excavate frons and peculiarly curved middle tarsal claws in which

the claws are turned strongly inward at the base with the posterior claw thicker than the anterior one.

The second major group on the basis of the enlargement of the eyes is somewhat smaller than the foregoing and is one in which the enlargement of the eyes proceeds laterally. This is accompanied by the narrowing of the anterior width of the vertex until the dorsal interocular space becomes almost parallel-sided with the synthlipsis remaining broad. The peak of this series is reached in *A. evansi* n. sp. and *A. tasmaniaensis* n. sp. in which the head is at least as wide as the pronotal humeral width and the synthlipsis is three-fourths the anterior width of the vertex.

Some of the specializations, which appear in completely unrelated forms are: the dorso-ventral enlargement of the male front femur; the projecting of the interocular space into an anterior cephalic horn; the facial tubercle becoming depressed, grooved, excavate or laterally compressed, and the elongation of the pronotum.

BIOLOGY AND DEVELOPMENT

Hale (13, 14) and Poisson (35) have both studied the biology and development of *Anisops,* using *Anisops thienemanni* Lundblad (= *Anisops hyperion* Hale, *nec.* Kirkaldy) and *Anisops sardea* Herrich-Schaffer respectively.

The members of this genus of backswimmers live in freshwater pools, lakes, and ponds; however at least one species, *A. sardea* is adapted to marine life as well. As with the other members of the family they swim on their backs and are predaceous, feeding on small crustaceans and mosquito larvae, which they hold securely beneath the bristles arming the margins of the fore and middle legs.

In order to replenish an air supply the insects ascends to the surface of the water where the venter is opened by the spreading apart of the guard hairs of the connexivum and keel. By the sudden closing of the guard hairs air is gathered in the longitudinal air troughs, after which the insect quickly darts down a few inches into the body of the water where it maintains almost perfect balance. Tendencies to rise or sink are offset by strokes of the swimming legs. Poisson points out that when fatigued the insect will sink to the bottom of the water and there remain on its back for a short period.

Preceding copulation there is an elaborate courtship during which, as recorded by Hale ". . . the male stridulating the while, poises below and a little behind the female, and in this position accompanies her every movement; finally with the extended posterior

legs quivering with excitement, he attempts to clasp her from below."

This stridulatory apparatus consists of a stridulatory comb borne on an expanded basal portion of the inner surface of each anterior tibia and a pair of chitinous prongs, one on each side of the third rostral segment. The stridulation is accomplished by rubbing the comb over the rostral prong.

The eggs are laid singly in stems of aquatic plants and to effect oviposition the female gouges a hole in the stem of the selected plant and inserts the egg leaving a small portion of the anterior surface exposed at the mouth of the cavity. The egg is oval and elongate and Poisson notes that the eggs of *A. sardea* bore two small appendages at the anterior end which he regarded as rudimentary pneumatic appendages.

The eggs hatch in about three weeks. There are five nymphal instars, the first four occupying each a little more than a week, with the fifth a little longer. Adulthood is reached in about two months. Hale points out that there are at least two generations a year.

The newly hatched nymphs are helpless until the air troughs are filled with air. During this period movement is awkward. A period of three days may elapse before the surface film is attained and the air troughs filled. Possibly during this period respiration is effected through the skin.

Anisops has almost perfect balance in the water and rarely clings to the plant stems as in the case of *Notonecta* and *Enithares.* This ability is likewise encountered in *Buenoa* which is quite similar to this genus in many respects.

DISTRIBUTION

The geographical range of *Anisops* extends throughout Africa, Madagascar and neighboring islands, the Mediterranean area, extending eastward to the islands of the South Pacific, thence northward into China and Japan, with *A. sardea* carrying its range along the entire eastern coast of Asia and, while this record is somewhat questionable, Fieber (11, 12) records it from Unalaska in the Western Hemisphere.

Although many species have been recorded from Asia as well as Africa, I have been able to find only two species whose distribution is so widespread, *Anisops sardea* which occurs throughout most of the generic range and *Anisops crinita* n. sp. which occurs in India as well as on the Mediterranean island of Corfu.

TECHNIQUES AND TERMINOLOGY

In order to interpret correctly the species descriptions, and to use them successfully, the reader should be acquainted with the technique and terminology employed herein.

The measurements of the head, pronotum and their respective parts were taken with the insect in a perfectly horizontal position. To view and measure the rostral prong, the specimen should be placed in a lateral position and the length of the prong measured from the base of the third rostral segment to the apex of the prong, along the posterior margin of the latter. To secure accurate measurement of the prong, the bug should be tilted until the prong is horizontal. The length of the third rostral segment is measured along its posterior margin.

To observe accurately and closely the chaetotaxy of the male front leg, the leg should be removed. This is best accomplished by placing the tip of a pin at the base of the coxa on its inner surface and applying a little outward pressure. The break is cleaner and accomplished with much less pressure if the specimen is dry and has not been relaxed. The leg should then be placed in a caustic potash solution until clear enough to observe. This clearing can be accomplished in a few minutes if the solution is hot, though not boiling. If placed in a cold solution, one day will be sufficient for clearing. It will be noted that my plates do not show the thick covering of hairs along the anterior half of the inner surface of the leg. These were purposely omitted so that the characteristic setae would not be obscured. The relative lengths of the parts of the legs are measured along the longest part of each segment.

Different workers in describing members of this genus have used different terms for the same structure. In the preparation of this manuscript, the most descriptive terms have been employed. Below is a short list of words and phrases with which the reader should be acquainted to fully understand the descriptions.

1. *Anterior width of the vertex*—the width of the interocular space lying between the anterior margins of the eyes as seen from above.
2. *Facial tubercle*—that portion of the frons immediately above the labrum.
3. *Frons*—the lower portion of the interocular space from the labrum to the anterior margin of the head.
4. *Interocular space*—that portion of the head between the eyes.
5. *Rostral prong*—the pair of projections borne on the third rostral segment, one on each side.
6. *Synthlipsis*—the narrowest dorsal portion of the interocular space immediately anterior to the pronotum.
7. *Stridulatory ridge*—the expanded portion of the inner basal surface of the anterior tibiae of the males bearing the stridulatory comb.

TAXONOMY OF THE GENUS ANISOPS

GENUS ANISOPS Spinola

(Type *A. sardea* Herrich-Shaffer)

1840. *Anisops* Spinola, Essais sur les Insectes Hemipteres, Rhyngotes ou Heteropteren, p. 58.

1851. *Anisops,* Fieber, Abhandl. Köngl. Bohmischen Ges. der Wiss., vol. V, pt. 7, pp. 481-482.

1865. *Anisops,* Stål, Hemiptera Africana, vol. III, p. 191.

1904. *Anisops,* Kirkaldy, Wiener Ent. Zeit., vol. XXIII, p. 111.

1926. *Anisops,* Jaczewski, Ann. Zool. Mus. Polonici Hist. Nat., vol. II, p. 81.

1929. *Anisops,* Hutchinson, Ann. South African Mus., vol. XXV, pt. 3, pp. 376-382.

Of the ninety-four species herein described, sixteen species, namely *Anisops ali* Distant, *Anisops alluaudi* Poisson, *Anisops aphrodite* Kirkaldy, *Anisops calcaratus* Hale, *Anisops canariensis* Noualhier, *Anisops ciliata* Stål, *Anisops endymion* Kirkaldy, *Anisops hyaline* Fieber, *Anisops lanceolata* Poisson, *Anisops letitia* Hutchinson, *Anisops mauricensis* Poisson, *Anisops meulenaerei* Poisson, *Anisops milloti* Poisson, *Anisops ocularis* Hale, *Anisops pugnax* Poisson, and *Anisops worthingtoni* Jaczewski, were not present in the material studied. In such cases I have presented the original descriptions and, when possible, I have included copies of the drawings on my plates. However, they were omitted from the key. The following is a key to the males of *Anisops.*

KEY TO MALES OF ANISOPS

1.		Synthlipsis wide, one third or more the anterior width of the vertex	2
		Synthlipsis narrow, less than one third the anterior width of the vertex	69
2.	(1)	Third rostral segment with prongs	3
		Third rostral segment without prongs—*A. agalia* Hutchinson	
3.	(2)	Along the median longitudinal axis, the head is one half or more as long as the pronotum	4
		Along the median longitudinal axis, the head is less than one half of the length of the pronotum	57
4.	(3)	Greatest width of the head less than seven times the anterior width of the vertex	5
		Greatest width of the head more than seven times the anterior width of the vertex	42
5.	(4)	Facial tubercle either longitudinally grooved, or excavate, or laterally compressed forming a median carina	32
		Facial tubercle neither longitudinally grooved, nor excavate, nor laterally compressed forming a median carina	6
6.	(5)	Interocular space projected anteriorly into a short cephalic horn	7
		Interocular space not projected anteriorly into a short cephalic horn	8
7.	(6)	Base of middle tibia with an inward projection which bears on its inner surface an oval patch of short, stout, closely set setae—*A. stali* Kirkaldy	
		Base of middle tibia not so formed—*A. campbelli* n. sp.	
8.	(6)	Over 6.5 mm. in length	24
		Less than 6.5 mm. in length	9

9. (8) Synthlipsis one half or more the anterior width of the vertex..... 20
Synthlipsis less than one half the anterior width of the vertex..... 10

10. (9) Apex of front femur rounded or truncate..... 17
Apex of front femur accuminate..... 11

11. (10) Inner surface of front tarsus without median small setae...*A. amaryllis* Hutchinson
Inner surface of front tarsus with one or more median small setae..... 12

12. (11) Inner surface of front tarsus with one basal median setae.....*A. elstoni* n. sp.
Inner surface of front tarsus with a median row of small setae..... 13

13. (12) Inner surface of front tarsus with a median row of three small setae in basal third 14
Inner surface of front tarsus with a median row of more than three small setae extending beyond the basal third..... 15

14. (13) Apex of rostral prong more or less rounded; stridulatory comb with longest teeth subapical .....*A. eros* Hutchinson
Apex of rostral prong accuminate; stridulatory comb with longest teeth at apex.....*A. kampalensis* Hutchinson

15. (13) Facial tubercle with a large patch of long erect hairs.....*A. paracrinita* n. sp.
Facial tubercle without a patch of hairs..... 16

16. (15) Labrum with basal width twice its median length.....*A. hackeri* n. sp.
Labrum with basal width less than twice its median length, *A. hyperion* Kirkaldy

17. (10) Anterior margin of pronotum bearing a large prominent tubercle behind the synthlipsis .....*A. tuberculata* Poisson
Anterior margin not bearing a large tubercle..... 18

18. (17) Third rostral segment bearing two nodules on its anterior median line
A. nodulata n. sp.
Third rostral segment not bearing nodules on anterior line..... 19

19. (18) Posterior margin of pronotum straight, not medianly emarginate...*A. apicalis* Stål
Posterior margin of pronotum medianly emarginate
A. canariensis perplexa Poisson

20. (9) Apex of front femur truncate or rounded..... 22
Apex of front femur accuminate..... 21

21. (20) Facial tubercle bearing a short erect spur.....*A. edepol* Kirkaldy
Facial tubercle not bearing a short erect spur.....*A. elstoni* n. sp.

22. (20) Second rostral segment with a flap-like extension along basal half of posterior surface .....*A. timorensis* n. sp.
Second rostral segment not so formed..... 23

23. (22) Viewed laterally the anterior margin of the third rostral segment overlaps at its apex the base of the fourth.....*A. occipitalis* Breddin
Viewed laterally the third rostral segment does not overlap the base of the fourth.....*A. coutierei* n. sp.

24. (8) Large, robust species over 9.0 mm. in length.....*A. pellucens* Gerstaeker
Less than 9.0 mm. in length..... 25

25. (24) Apex of front femur accuminate..... 26
Apex of front femur rounded or truncate..... 30

26. (25) Anterior margin of fore tibia with a row of eleven prominent setae extending from basal third to apex.....*A. malkini* n. sp.
Anterior margin of fore tibia without such a row of setae..... 27

27. (26) Greatest width of head equal to the pronotal humeral width.....*A. evansi* n. sp.
Greatest width less than the pronotal width..... 28

28. (27) Inner surface of fore tarsi with only a median large, stout setae at base
A. gratus Hale
Inner surface of fore tarsi with a median longitudinal row of small setae.... 29

29. (28) Greatest width of head five times the anterior width of the vertex *A hyperion* Kirkaldy

Greatest width of head less than five times the anterior width of the vertex ..... *A. gobana* Poisson

30. (25) Dorsal margin of anterior femur with a slight concavity at apical third..... 31

Dorsal margin of anterior femur without a slight concavity..... *A. varia* Fieber

31. (30) Greatest width of head equal to the pronotal humeral width; pronotal lateral margins convex and converging..... *A robusta* Hutchinson

Greatest width of head less than the pronotal humeral width; pronotal lateral margins almost straight and diverging..... *A. occipitalis* Breddin

32. (5) Large species, 9.0 mm. or more in length; frons with a median longitudinal row of erect hairs..... *A. sikorensis* n. sp.

Less than 9.0 mm. in length; frons without a median row of hairs..... 33

33. (32) Facial tubercle laterally compressed forming a median carina..... 34

Facial tubercle not laterally compressed forming a median carina..... 36

34. (33) Rostral prong longer than third rostral segment..... *A fijiensis* n. sp.

Rostral prong shorter than third rostral segment..... 35

35. (34) Fore tarsus two thirds the length of the fore tibia..... *A. adonis* Hutchinson

Fore tarsus less than two thirds the length of the fore tibia *A. jaczewski* Hutchinson

36. (33) Inner surface of anterior tibia with two pairs of short stout setae at its anterior margin midway between the base and apex..... 37

Inner surface of anterior tibia without such setae..... 38

37. (36) Base of middle tibia with an inward projection which bears on its inner surface an oval patch of short, stout, closely-set setae..... *A. stali* Kirkaldy

Base of middle tibia not so formed..... *A. campbelli* n. sp.

38. (36) Facial tubercle with a median longitudinal groove..... 39

Facial tubercle not so..... 40

39. (38) Ridges bordering longitudinal groove provided with long erect hairs *A. semita* n. sp.

Ridges bordering longitudinal groove not provided with long erect hairs *A. canaliculata* n. sp.

40. (38) Middle tarsal claws strongly curved inward at base; posterior claw thicker than anterior one..... 41

Middle tarsal claws not strongly curved inward at base; posterior and anterior claws the same width..... *A psyche* Hutchinson

41. (40) Frontal excavation bordered by two ridges on each side..... *A genji* Hutchinson

Frontal excavation bordered by only one ridge..... *A nivea* (Fabricius)

42. (4) Greatest width of head equal to or more than pronotal humeral width..... 54

Greatest width of head less than pronotal humeral width..... 43

43. (42) Facial tubercle laterally compressed forming a median carina..... 44

Facial tubercle not laterally compressed..... 46

44. (43) Apex of front femur truncate or rounded..... 45

Apex of front femur accuminate..... *A fijiensis* n. sp.

45. (44) Vertex not extending beyond the anterior margins of the eyes *A. tahitiensis* Lundblad

Vertex extending slightly beyond the anterior margins of the eyes *A. lipovskyi* n. sp.

46. (43) Synthlipsis less than one half the anterior width of the vertex..... 47

Synthlipsis one half or more the anterior width of the vertex..... 50

47. (46) Inner surface of fore tarsi provided with a median row of five small setae extending from base to apex..... *A. deanei* n. sp.

Inner surface of fore tarsi not provided with a median row of setae extending from base to apex..... 48

48. (47) Rostral prong shorter than third rostral segment.....*A. philippinensis* n. sp.
Rostral prong longer than third rostral segment..... 49

49. (48) Inner surface of fore tarsi without a row of small setae.....*A. eleopatra* Distant
Inner surface of basal fourth of fore tarsi with a short row of four setae
A. praetexta Hutchinson

50. (46) Large species; over 8.0 in length..... 51
Less than 8.0 in length..... 52

51. (50) Facial tubercle with two median tufts of hairs.....*A. barbata* n. sp.
Facial tubercle without two tufts of hairs.....*A. grandis* Poisson

52. (50) Apex of front femur rounded or truncate.....*A. tanalensis* n. sp.
Apex of front femur not accuminate..... 53

53. (52) Rostral prong slightly shorter than third rostral segment..*A. philippinensis* n. sp.
Rostral prong at least as long as the third rostral segment.....*A windi* n. sp.

54. (42) Apex of front femur rounded.....*A. leucothea* Esaki
Apex of front femur accuminate..... 55

55. (54) Pronotal lateral margins parallel.....*A. doris* Kirkaldy
Pronotal lateral margins diverging..... 56

56. (55) Greatest width of head seven to eight times the anterior width of the vertex; over 7.0 mm. in length.....*A. tasmaniaensis* n. sp.
Greatest width of head ten times the anterior width of the vertex; less than 6.0 mm. in length.....*A. philippinensis* n. sp.

57. (3) Facial tubercle swollen into a triangular eminence; apex accuminate
A. wakefieldi White
Facial tubercle not so formed..... 58

58. (57) Facial tubercle excavate or longitudinally grooved..... 59
Facial tubercle not as above..... 60

59. (58) Facial tubercle deeply excavate.....*A. hancocki* Hutchinson
Facial tubercle longitudinally grooved.....*A. canaliculata* n. sp.

60. (58) Pronotal lateral margins almost parallel..... 68
Pronotal lateral margins diverging..... 61

61. (60) Median length of pronotum three fourths the humeral width..... 67
Median length of pronotum less than three fourths the median length..... 62

62. (61) Front femur with apex curved..... 64
Front femur with apex accuminate..... 63

63. (62) Pronotum with a deep median longitudinal depression; greatest width of head eight tenths pronotal humeral width.....*A. gratus* Hale
Pronotum without median longitudinal depression; greatest width of head nine tenths pronotal humeral width.....*A. decipiens* Hutchinson

64. (62) Less than 6.0 mm. in length..... 65
6.0 mm. or more in length..... 66

65. (64) Front femur greatly enlarged dorso-ventrally; dorsal margin strongly convex .....*A. barrenensis* n. sp.
Front femur not greatly enlarged; dorsal margin not strongly convex
A. hungerfordi Poisson

66. (64) Dorsal and ventral margins almost parallel for the basal three fourths of their length .....*A. ares* Hutchinson
Dorsal and ventral margins converging from the base.....*A. varia* Fieber

67. (61) Viewed laterally, the interocular space not swollen beyond the margins of the eyes.....*A. paranigrolineata* n. sp.
Viewed laterally, the interocular space is swollen beyond the margins of the eyes.....*A. nigrolineata* Lundblad

68. (60) Greatest width of head equal to pronotal humeral width.....*A. assimilis* White
Greatest width of head less than pronotal humeral width
A. thienemanni Lundblad

69. (1) Interocular space produced anteriorly into a cephalic projection..... 70
Interocular space not produced anteriorly into a cephalic projection..... 76

70. (69) Frons not excavate for its entire length.....*A. nasuta* Fieber
Frons excavate 71

71. (70) Cephalic projection rounded at apex..... 72
Cephalic projection more or less accuminate..... 73

72. (71) Basal third of fore tibia with a large procumbent spine which lies on the dorsal surface.....*A. cavifrons* n. sp.
Basal third of fore tibia without such a spine.....*A. batillifrons* Lundblad

73. (71) Inner surface of fore tibia with five prominent setae extending from basal fourth to apex..... 74
Inner surface of fore tibia without such setae..... 75

74. (73) Basal two tibial setae of anterior leg spatulate; tip of the cephalic projection not black.....*A. sardea* Herrick-Shaffer
Basal two tibial setae of anterior leg not spatulate; tip of the cephalic projection black.....*A. madagascarensis* Poisson

75. (73) Viewed on inner surface, subapical fifth of fore tibia angulate, *A bouvieri* Kirkaldy
Viewed on inner surface, apex of tibia rounded.....*A. extendofrons* n. sp.

76. (69) Facial tubercle excavate, with lateral margins carinate.....*A. nivea* Fieber
Facial tubercle not excavate, at most only slightly depressed..... 77

77. (76) Stridulatory ridge transversely striated..... 78
Stridulatory ridge not transversely striated..... 79

78. (76) Facial tubercle with faint median depression; rostral prong rounded at apex .....*A. graciloides* n. sp.
Facial tubercle not faintly depressed; rostral prong accuminate at apex
A. gracilis Hutchinson

79. (76) Longer claw of front leg more than one half as long as front tarsi..... 80
Longer claw of front leg not more than one half as long as fore tarsi..... 81

80. (79) Facial tubercle greatly swollen.....*A. paweri* Hutchinson
Facial tubercle not greatly swollen.....*A. leesoniana* Hutchinson

81. (79) Eyes holoptic in basal half of dorsal surface..... 82
Eyes not holoptic..... 83

82. (81) Pronotal lateral margins parallel.....*A. breddeni* Kirkaldy
Pronotal lateral margins diverging.....*A. kempi* n. sp.

83. (81) Greatest width of head seven times or more the anterior width of the vertex 91
Greatest width of head less than seven times the anterior width of vertex.... 84

84. (83) Facial tubercle covered with hairs..... 85
Facial tubercle not covered with hairs..... 86

85. (84) Hairs of facial tubercle long and erect.....*A. paracrinita* n. sp.
Hairs of facial tubercle short and procumbent.....*A. crinita* n. sp.

86. (84) Inner surface of anterior tibia provided with stout setae along the apical two thirds of its anterior margin..... 87
Inner surface of fore tibia not so armed..... 88

87. (86) Synthlipsis extremely narrow, approximately one tenth the anterior width of the vertex; apex of front femur rounded.....*A. majiensis* n. sp.
Synthlipsis one sixth the anterior width of the vertex; apex of fore femur accuminate .....*A. debilis* Gerstacker

88. (86) Over 6.5 mm. in length ..... *A. gratus* Hale
Less than 6.5 mm. in length 89

89. (88) Rostral prong shorter than third rostral segment; apex rounded
A. exigera Horvath
Rostral prong longer than third rostral segment; apex accuminate 90

90. (89) Facial tubercle flat ..... *A. vitrea* Signoret
Facial tubercle slightly raised, not flat ..... *A. hypatia* Hutchinson

91. (83) Facial tubercle slightly raised and flattened on ventral surface 92
Facial tubercle not flattened on ventral surface 93

92. (91) Small species, less than 5.5 mm. in length ..... *A. vitrea* Signoret
Over 6.0 mm. in length ..... *A. balcis* Hutchinson

93. (91) Anterior tarsus without a median row of small setae on inner surface 94
Anterior tarsus with a median row of small setae on inner surface 95

94. (93) Dorsal margin of third rostral prong appears to arise near the apex of third rostral segment ..... *A. biroi* n. sp.
Dorsal margin of third rostral prong appears to arise in basal half of third rostral segment ..... *A. rigoensis* n. sp.

95. (93) Anterior tarsus with a median row of five small setas on inner surface
A. deanei n. sp.
Anterior tarsus with a median row of three small setae on inner surface
A. waltairensis n. sp.

Anisops agalia Hutchinson

(Pl. XXXVI, fig. 7)

1929. *Anisops agalia* Hutchinson, Ann. South African Mus., vol. XXV, pt. 3, pp. 404-406, Pl. XXIX, fig. 4, Pl. XXXII, fig. 7, 7a.
1933. *Anisops agalia*, Hutchinson, Internat. Rev. ges. Hydrob. und Hydrog., vol. 28, pt. 5/6, pp. 446, 459, 460 (ecological notes).

Size.—Males, length 5.9 mm., greatest body width 1.5 mm.; females, length 6.6 mm., greatest body width 2.1 mm.

Shape.—Fusiform species; greatest body width about two fifths the body length.

Color.—General facies stramineous. Eyes brown. Legs stramineous. Abdominal venter dark brown.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width of the head slightly less than the humeral width of the pronotum and almost four times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is two thirds the length of the pronotum. Pronotum with its humeral width almost twice its median length; lateral margins diverging and almost one half the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised. Labrum short with its basal width one and one half the median length; apex truncate, almost one-third the basal width. Third rostral segment lacking rostral prongs. Stridulatory comb (Pl. XXXVI, fig. 7b)

of approximately six, even-length teeth. Anterior tibia with its inner surface covered with procumbent spatulate setae. Chaetotaxy of the front leg as shown on Plate XXXVI. The relative lengths of the parts of the legs are as follows:*

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	128	86	..

Female structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width of the head approximately eight tenths the pronotal humeral width and four times the anterior width of the vertex; synthlipsis wide, more than one third the anterior width of the vertex; along the median longitudinal axis the head is almost one-half the length of the pronotum. Pronotum with its humeral width twice its median length; lateral margine diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	119	56	31
Middle leg	100	78	36	22
Hind leg	100	79	43	46

Location of types.—Type, allotype, and paratypes from Cape, Transvaal in the South African Museum.

Comparative notes.—By its lack of rostral prongs, *A. agalia* Hutchinson is different from all other known species of *Anisops*. However, it appears similar to *A. hypatia* from which it can be readily separated by the fact that the males of *A. hypatia* lack the spatulate front tibial hairs as found on the males of *A. agalia* as well as by the presence of rostral prongs.

Data on distribution:

SOUTH AFRICA

Vlei Roxana, 1-21-1927, C. F. Mobray, one male, one female, gift to H. B. H. from G. E. Hutchinson. (F. H. Snow Coll.)

Anisops stali Kirkaldy

(Pl. XXXVII, fig. 9; Pl. LVII, fig. 107)

1855. *Notonecta australis* Stål, Ofversigt af Kongl. Vet. Akad. For., vol. VII, p. 89. (*nec* Oliver).

1859. *Notonecta australis*. Stål, Eugenies Resa, p. 267.

1904. *Anisops stali*, Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 113, 132.

1923. *Anisops stali*, Hale, Rec. South Australian Mus., vol. II, no. 3, pp. 414-415, fig. 368.

1925. *Anisops stali*, Hale, Archiv för Zoologi utgivit av. K. Svenska Vetenskapsakademien, vol. 17, no. 20, p. 17 (ecological note).

* The single male specimen at my disposal was minus the two hind pairs of legs.

1933. *Anisops stali,* Lundblad, Arch. für Hydrob., Suppl., vol. XII, p. 146 (list of Indo-australian species of this genus).

1934. *Anisops stali,* Hungerford, Bull. Brooklyn Ent. Soc., vol. XXIX, p. 69 (ecological note).

Size.—Males, length 9.0 mm.-10.6 mm., greatest body width 2.5 mm.-2.8 mm.; females, length 8.5 mm.-10.2 mm., greatest body width, 2.4 mm.-2.9 mm.

Shape.—Large fusiform species; greatest body width about four tenths body length.

Color.—Brown form: General facies stramineous. Eyes brown. Pronotum may be orange or tinged with orange. Hemelytra may be hyaline and appear darker due to underlying dark dorsal body surface. *Gray form*: General facies gray; eyes brown or gray. Hemelytra hyaline and appear gray due to the black dorsal body surface. Legs of both forms stramineous. Abdominal venter dark brown or black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the vertex extending beyond the anterior margins of the eyes; greatest width of the head eight to nine tenths the pronotal humeral width and three to four times the anterior width of the vertex; synthlipsis wide, two thirds the anterior width of the vertex; along the median longitudinal axis the head is one half as long as the pronotum. Pronotum with its humeral width twice its median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. Frons concavely depressed with apex extending slightly beyond the anterior margins of the eyes to form a short cephalic horn; facial tubercle with a horseshoe-shaped protruding area immediately anterior to the labrum, surrounded by a deep depression. Labrum long, with its median length one and three fourths its basal width; apex more or less accuminate. Rostral prong (Pl. LVII fig. 107) shorter than the third rostral segment; apex more or less accuminate. Anterior margin of the third rostral segment with long procumbent hairs on each side, extending to the apex. Stridulatory comb (Pl. XXXVII fig. 9b) with a highly variable number of teeth, varying from fifteen to twenty-five. Chaetotaxy of male front leg as shown on Plate XXXVII. Base of the middle tibia with a short inward projection which bears on its inner surface a circular group of thickly-set, stout, even-length setae;

basal third of middle tibia with a strong concavity on anterior margin. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	65	?
Middle leg	100	84	34	23
Hind leg	100	83	33	30

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head eight to nine tenths the pronotal humeral width and three to four times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior width of the vertex; along the median longitudinal axis the head is almost one half the length of the pronotum. Pronotum with its humeral width almost twice its median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	125	48	29
Middle leg	100	83	36	22
Hind leg	100	77	35	30

Location of types.—Type material from Australia, in the Stockholm and Paris Museums.

Comparative notes.—This species along with *Anisops pellucens* Gerstacker are two of the largest species within this genus. However, they are not readily confused with one another as the males of *A. pellucens* lack the short cephalic horn, and the circular group of basal setae on the middle tibiae as found on the males of *A stali.*

Data on distribution:

Australia

New South Wales, one male (F. H. Snow Coll.)

Broken Hill, X-4-44, C. E. Chadwick, two males (Dept. of Agric., N. S. W., Austral.)

New South Wales, Coolebah, 1904, one male, one female (Dept. of Agric., N. S. W., Austral.)

New South Wales, Hay, Lea, one male (Dept. of Agric., N. S. W., Austral.)

New South Wales, Brewarrina, June, 1944, W. W. Froggatt, one female (Dept. of Agric., N. S. W., Austral.)

West Australia, Wiluna, Oct. 19, 1931, Harv. Austral. Exped., P. J. Darlington, seven males, four females (Harv. Mus. Comp. Zool.)

Queensland, Brisbane, Dec. 1922, H. Hacker, one female (F. H. Snow Coll.)

Queensland, Duaringa, two males, two females (F. H. Snow Coll.)

Cordilla Downs, one male, one female (F. H. Snow Coll.)
Cordilla Downs, VII-16-'88, F. Archer, one female (F. H. Snow Coll.)
Townesville, Jan. 1945, B. Malkin, one female (U. S. Nat. Mus.)
Australia, II-'47, Verreaux, one female (F. H. Snow Coll.)

TIMOR

Soe, 1935, Buhler, five males, five females (F. H. Snow Coll.); twelve males, fourteen females (Basel Nat. Hist. Mus., Switzerland).
Soe, June, 1935, C. Buhler and Meyer, three males, one female (Basel Nat. Hist. Mus., Switzerland).

CELEBES

Lahendong, six females (Basel Nat. Hist. Mus., Switzerland).

OKINAWA

Okinawa, Sept. 30, 1945, W. D. Fields, four males, one female (U. S. Nat. Mus.).

PHILIPPINE ISLANDS

Mindanao, Baker, one female (U. S. Nat. Mus.).

Anisops campbelli n. sp.

(Pl. XXXVII, fig. 8)

Size.—Males, length 7.3 mm.-8.1 mm., greatest body width 2.1 mm-2.2 mm.; females, length 8.1 mm.-8.4 mm., greatest body width 2.2 mm.-2.5 mm.

Shape.—Fusiform, with greatest body width between one third and one half the body length.

Color.—Brown form: General facies stramineous. Eyes brown. Vertex may be tinged with dark brown and hemelytra may be hyaline at apex, appearing dark brown as it overlies the dark brown dorsal surface of the abdomen. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous. *Gray form*: General facies gray; legs testaceous; abdominal venter dark brown with keel and segmental margins of the connexivum gray.

Male structural characteristics.—As viewed from above, the outline of the head is rounded with the vertex extending slightly beyond the anterior margin of the eyes; greatest width of head nine tenths the pronotal humeral width and three to four times the anterior width of the vertex; synthlipsis wide, slightly less than two thirds the anterior width of the vertex; along the median longitudinal axis the head is one half the pronotal length. Pronotum with a faint median ridge on anterior half; humeral width at least twice its median length; lateral margins diverging and one half of the median length; posterior margin convex, medianly concave. Viewed ven-

trally the frons is slightly concave with the facial tubercle flat; apex delinited by a transverse ridge which projects slightly beyond the margin of the head. Rostral prong (Pl. XXXVII fig. 8b) shorter than third rostral segment; apex accuminate. Third rostral segment with a procumbent tuft of hairs along each side of the dorsal surface. Labrum long, with median length one and one-fourth times its basal width; apex truncate. Stridulatory comb (Pl. XXXVII fig. 8c) of approximately eighteen teeth which increases in height from base to apex. Anterior margin of innner surface of front tibia with a short row of two pairs of stout setae. Chaetotaxy of the male front leg as shown on Plate XXXVII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	133	60	..
Middle leg	100	81	54	21
Hind leg	100	83	35	30

Female structural characteristics.—Viewed from above, the anterior outline of the head is rounded with the anterior margin of the vertex extending slightly beyond that of the eyes; greatest width of the head slightly more than eight tenths the pronotal humeral width and three to four times the anterior width of the vertex; synthlipsis wide, two thirds the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the pronotal length. Pronotum with a faint median ridge on the anterior half; humeral width slightly less than twice the median length; lateral margins diverging almost three fourths the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	125	44	24
Middle leg	100	82	35	23
Hind leg	100	87	34	31

Location of types.—Male holotype, female allotype, three males, one female paratype, Chikkaballapura, S. India, T. V. Campbell in the Snow Entomological Collection. Other paratypes are as follows. In the Snow Entomological Collection: one male, three females, Lucknow, India, I-22-08, Mus. Collr. R. H. In the Indian Museum at Calcutta: Kandaghat, Simla Hills, 3500'-4600', Sta. 2, Pond, VIII-'25, B. Chapra; one male, two females, Punjab, Salt Range, Sta. 9, S. L. Hora; four males, three females, Darjiling Dist. E. Himalayas, Nam Ting Pokri above Sitong nr. Mangpur 4800', VII-2-18, S. Kemp; one male, Lucknow, II-4-08, Mus. Collr. R. H.;

five females, Lucknow, II-5-08, Mus. Collr. R. H.; one male, Lucknow, I-16-08, Mus. Collr. R. H.; two males, one female, Lucknow, I-17-08, Mus. Collr. R. H.

Comparative notes.—Though somewhat smaller, this species appears closely related to *Anisops stali* Kirkaldy, as all the distinctive features as borne by the latter species are also present on *A. campbelli* though much reduced in prominence. The two species may be readily separated since the middle tibiae of the males of the latter species lack the inward basal projection bearing the circular group of thickly set, stout, even-length setae as found on *A. stali.*

Data on distribution:

BURMA

S. Shan States, Yawaghee, Heho, 3800, III—29-17, Gravely, one male, one female (Bueno Coll. of F. H. Snow Coll.).

INDIA

Darjeeling, Le Moult, one male, one female (Bueno Coll. of F. H. Snow Coll.).

Kalka, base of W. Himalayas, V—16-11, N. Annandale, two males, one female (F. H. Snow Coll.).

S. India, Bangalore, 3000, X—16-10, Annandale, one female (F. H. Snow Coll.).

Patiala State, Dhurampor, base of Simla Hills, VII—21-11, one female (F. H. Snow Coll.).

Anisops amaryllis Hutchinson

(Pl. XXXVI, fig. 6)

1928. *Anisops amaryllis* Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. I, text fig. 5.

1930. *Anisops amaryllis,* Hutchinson, Ann. Mag. Nat. Hist., vol. VI, Ser. 10, pp. 58-59 (ecological note).

1933. *Anisops amaryllis,* Jaczewski, Linn. Sci. Jour., Zool., vol. XXXVII, p. 345 (ecological note).

Size—Males, length 5.4 mm.-6 mm., greatest body width 1.5 mm.-1.8 mm.; females, length, 5.3 mm.-6.3 mm., greatest body width 1.5 mm.-1.9 mm.

Shape—Small, subfusiform species; lateral margins in anterior half of body almost parallel, converging in posterior half.

Color—Light form: General facies testaceous. Eyes brown. Hemelytra may appear dark gray as it is hyaline and overlies the dark brown or black dorsal body surface. Legs stramineous. Abdominal venter dark brown or black with keel and segmental margins of the connexivum stramineous. *Dark form:* General facies black. Eyes dark brown. Vertex and pronotum testaceous. Scutellum dark brown or black; lateral margins may be crimson. Hemelytra hyaline and appear dark gray as they overlie the black dorsal body

surface; margins bordering the scutellum may be tinged with crimson. Leg stramineous. Abdominal venter with keel and segmental margins of the connexivum stramineous.

Male structural characteristics—Viewed from above, the outline of the head is rounded with the greatest width of the head nine tenths the pronotal humeral width and almost six times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is slightly shorter than the pronotum. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and one-half the median length; posterior margin convex, medianly emarginate. Rostral prongs (Pl. XXXVI, fig. 6b) as long as the third rostral segment; apex more or less rounded. Stridulatory comb (Pl. XXXVI, fig. 6c) of approximately twelve even length teeth. Chaetotaxy of the male front leg as shown on Plate XXXVI. The relative lengths of the parts of the legs are as follows:*

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	117	73	..
Middle leg	100	77	38	25

Female structural characteristics—Viewed from above, the outline of the head is rounded; greatest width of the head eight-tenths the pronotal humeral width and five times the anterior width of the vertex; synthlipsis wide, slightly less than one-half the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one-half the length of the pronotum. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	125	58	28
Middle leg	100	87	43	26
Hind leg	100	84	33	33

Location of types.—Male type from British East Africa (now Kenya Colony) Nairowa Pass, C. S. Betton in the British Museum.

Comparative notes. — This species appears closely allied to *Anisops eros* Hutchinson from which it can be separated by the shape of the stridulatory comb and the chaetotaxies of the front legs of the males. In the latter species the distal teeth of the stridualtory comb are elongate, more than twice as long as the basal elements, whereas in *A. amaryllis* all the teeth of the comb are approximately the same length. The row of three small spines as

* None of the males at my disposal possessed a complete hind leg.

found on the basal inner surface of the male front tarsi of *A. eros* is lacking on the tarsi of the male of *A. amaryllis.*

Data on distribution:

AFRICA

Central Africa, one male, (Basel Nat. Hist. Mus., Switzerland).

Uganda, Lake Naivasha, E. B. Worthington, exchange from the British Museum, one male, one female (F. H. Snow Coll.).

South Rhodesia, Mazoe Valley, VI-10-28, A. Cuthberson, two males, one female (F. H. Snow Coll.).

Anisops elstoni n. sp.

(Pl. XXXVI, fig. 5)

Size.—Males, length 4.3 mm.-4.6 mm., greatest body width 1.2 mm.-1.3 mm.; females, length 5.1 mm.-5.5mm., greatest body width 1.4 mm.-1.6 mm.

Shape.—Small, subfusiform species; anterior half of body with lateral margin only slightly converging, subparellel, those of posterior half converging.

Color.—General body color stramineous. Eyes brown. Scutellum may be orange or tinged with orange with anterior margin black. Hemelytra hyaline and may have margins adjacent to scutellum orange. Legs stramineous. Abdominal venter dark brown or black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width nine tenths pronotal humeral width, six times the anterior width of vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is at least three fourths the pronotal length. Pronotum with a large median depression; humeral width slightly more than twice the median length; lateral margins diverging and at least one half the median length; posterior margin convex, medianly concave. Facial tubercle flat. Labrum with a few short hairs; basal width equal to median length; apex rounded. Rostral prong longer than third rostral segment. Stridulatory comb (Pl. XXXVI, fig. 5c) composed of about thirteen teeth; apical two greatly reduced in size. Chaetotaxy of the male front leg as shown on Plate XXXVI, fig. 5a. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	115	77	..
Middle leg	100	79	48	24
Hind leg	100	79	31	33

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width nine tenths the pronotal humeral width, five to six times the anterior width of the vertex; synthlipsis wide, slightly more than one third the anterior width of the vertex; along median longitudinal axis the head is slightly more than three fourths the pronotal length. Pronotum with a faint median depression; humeral width slightly more than twice its median length; lateral margins diverging and one half the median length. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	118	57	36
Middle leg	100	80	37	26
Hind leg	100	79	33	33

Location of types.—Male holotype, female allotype, three male and one female paratypes, S. Australia, Myponga, A. H. Elston, in the Snow Entomological Collection. Other paratypes are as follows. In the Snow Entomological Collection: one male, six females Australia, Brisbane, Queensland, Dec. 1933, H. Hacker; one male, Suifu Szecheun, China, D. C. Graham. In the Harvard Museum of Comparative Zoology: three males, three females, New South Wales, The Dorrigo, 3000′, Feb. 1932, Darlington, Harv. Austrl. Exped.

Comparative notes.—A very small species of the same general appearance as *Anisops exigera* Horvath. However the males of this species have a much narrower synthlipsis, one fifth to one sixth the anterior width of the vertex, whereas in *A. elstoni* the synthlipsis is wide, at least one third the anterior width of the vertex. The rostral prong of *A. exigera* is shorter than the third rostral segment and rounded at the apex while that of *A. elstoni* is longer than the third rostral segment and accuminate at the apex.

Data on distribution.—Known only from type series.

Anisops eros Hutchinson*

(Pl. XXXVII, fig. 10)

1928. *Anisops eros* Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. I, pp. 160-161, text fig. 4.

1933. *Anisops eros*, Jaczewski, Linn. Soc. Jour. Zool., Vol. XXXVIII, p. 345 (ecological note).

1933. *Anisops eros*, Hutchinson, Internat. ges. Hydrob. und Hydrog., vol. 28, pt. 5/6, p. 462 (ecological note).

1937. *Anisops eros*, Poisson, Ann. Soc. Ent. France, vol. CVI, p. 117, text fig. 2.

1948. *Anisops eros*, Poisson, Rev. Francaise Ent., vol. XV, p. 168 (ecological note).

Size.—Male, length 4.8 mm., greatest body width 1.2 mm.

Shape.—Small fusiform species; greatest width midway the body length.

* Only a single male specimen of this species was in my material.

Color.—General facies testaceous. Eyes gray brown. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the anterior margin almost straight; greatest width of the head nine tenths the pronotal humeral width and slightly more than six times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior width of the vertex; along the medial longitudinal axis the head is almost as long as the pronotum. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and almost one half the median length; posterior margin convex, medianly emarginate. Facial tubercle only slightly raised. Labrum with its median length slightly less than its basal width; apex rounded. Rostral prong (Pl. XXXVII, fig. 10b) longer than the third rostral segment; apex more or less rounded. Stridulatory comb (Pl. XXXVII, fig. 10c) of approximately fourteen teeth which increase in length toward the middle. Chaetotaxy of the front leg as shown on Plate XXXVII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	127	91	..
Middle leg	100	80	40	25
Hind leg	100	80	33	33

Location of types.—Type material from Uganda, Kampala, III-20-1927, G. L. R. Hancock, in the British Museum.

Comparative notes.—This species is very similar to *Anisops amaryllis* Hutchinson from which it can be successfully separated by the fact that the males of *A. eros* have a short row of three small setae on the inner surface of the basal half of the fore tarsi, which is lacking on the fore tarsus of *A. amaryllis.*

Data on distribution:

AFRICA

Tanganyika Terr., Amani, Feb. 19, 1940, F. X. Williams, one male (Harv. Mus. Comp. Zool.).

Anisops kampalensis Hutchinson*

(Pl. XXXVIII, fig. 15)

1928. *Anisops kampalensis* Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. I, pp. 162-163, text fig. 6.

1933. *Anisops kampalensis*, Hutchinson, Internationale der gesamten Hydrobiologie und Hydrographie, vol. 28, prt. 5/6, p. 462 (ecological note).

Size.—Males, length 4.9 mm., greatest body width 1.3 mm.

* Only two male specimens were available for study.

Shape.—Small, robust, subfusiform species; greatest body width midway the body length.

Color.—General facies black. Eyes brown. Vertex, pronotum testaceous, the latter with irregular hyaline areas on posterior margin, such areas appear black due to the color of the underlying scutellum. Scutellum testaceous with anterior half black. Hemelytra hyaline and appear black due to the black color of the dorsal body surface. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal humeral width and five times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is one half the length of the pronotum. Pronotum with its humeral width almost twice the median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised. Labrum broad, basal width equal to the median length; apex rounded. Rostral prong (Pl. XXXVIII, fig. 15b) as long as the third rostral segment; apex accuminate. Stridulatory comb (Pl. XXXVIII, fig. 15c) of approximately eleven teeth, the apical four longer than the basal eight. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	117	88	..
Middle leg	100	82	37	27
Hind leg	100	82	30	30

Location of types.—Type material from Kampala, Uganda in the British Museum.

Comparative notes.—This species is very similar to *A. adonis* Hutchinson, however, the males lack the carinate frons of the latter species.

Data on distribution:

Africa

Huat Owanhui, Bessou (Mission) Amont de Fort de Passel, Ouacha, 1804, Dr. J. DeCorse, one male (F. H. Snow Coll.).

Mission Tilho, Ouacha, 1910, Dr. R. Gaillard, one male (Paris Museum).

Anisops paracrinita n. sp.

(Pl. XXXVIII, fig. 12)

Size.—Males, length 4.8 mm., greatest body width 1.3 mm.; females, length 4.8 mm., greatest body width 1.3 mm.

Shape.—Small, fusiform species; greatest body width about midway its body length.

Color.—General facies brown. Eyes brown. Vertex, pronotum and scutellum testaceous, the latter dark brown on apical half. Hemelytra hyaline and appearing brown due to the underlying brown dorsal body surface. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width eight tenths the pronotal humeral width and slightly more than six times the anterior width of the vertex; along the median longitudinal axis the head is almost as long as the pronotum. Pronotum with its humeral width slightly more than two and one half times its median length; lateral margins diverging and three fifths the median length; posterior margin convex, medianly emarginate. Facial tubercle with a triangular patch for long hairs whose outer ones are erect. Labrum covered with long hairs; basal width slightly more than its median length; apex rounded. Rostral prong (Pl. XXXVIII, fig. 12b) shorter than the third rostral segment; apex accuminate. Stridulatory comb (Pl. XXXVIII, fig. 12c) of eleven even-length teeth. Chaetotaxy of the front leg as shown on Plate XXXVIII. The relative lengths of the parts of the legs are as follows.

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	90	..
Middle leg	100	76	40	26
Hind leg	100	71	33	33

Female structural characteristics.—Viewed from above, the outline of the head is rounded with its greatest width almost nine-tenths the pronotal humeral width and slightly more than four times the anterior width of the vertex; synthlipsis wide almost one half the anterior width of the vertex; along the median longitudinal axis the head is more than one half the median length. Pronotum with its humeral width two and one fourth times the median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	126	60	40
Middle leg	100	81	40	25
Hind leg	100	81	33	33

Location of types.—Male holotype Queensland, Australia, Coen. C. York, May '32, Harv. Austrl. Exped. Darlington, in the Harvard Museum of Comparative Zoology. Female allotype, one male and one female paratype, Moore Id. Australia, Feb. 20, 1945, B. Milkin in the United States National Museum.

Comparative notes.—Very similar to *Anisops crinita* n. sp. but the two species may be readily separated on the basis of the males. The male of *A. paracrinita* has long hairs on the facial tubercle and for the most part these are erect, whereas the facial tubercle of *A. crinita* has short procumbent hairs. Also the synthlipsis of the latter is much narrower being only at most one fifth the anterior width of the vertex. For comparison of the front legs of the males see Pl. XXXVIII, fig. 12a and Pl. I, fig. 68a.

Data on distribution.—Known only from type series.

Anisops hackeri n. sp.

(Pl. XXXVIII, fig. 13)

Size—Males, length, 5.5 mm.-5.7 mm., greatest body width 1.4 mm.-1.6 mm.; females, length 5.7 mm.-6.0 mm., greatest body width 1.5 mm.-1.7 mm.

Shape—Short, robust, subfusiform species; lateral margins of anterior half of body almost parallel.

Color—Eyes brown; vertex and pronotum testaceous, the former may be tinged with orange, the latter may have its posterior margin hyaline and appear the black color of the underlying surface of the scutellum. Scutellum orange, black along its apical margin. Hemelytra hyaline and appearing gray as it overlies the black dorsal body surface. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal humeral width; five times the anterior width of the vertex; synthlipsis wide, slightly less than one half the anterior width of the vertex; along the median longitudinal axis the head is three fifths the pronotal length. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and three fifths the median length; posterior margin convex, slight median emargination. Facial tubercle simple only slightly raised. Labrum with its basal width slightly more than its median length; apex rounded. Rostral prong (Pl. XXXVIII, fig. 13b) as long as the third rostral segment; apex accuminate. Stridulatory comb

(Pl. XXXVIII, fig. 13c) of approximately twenty-four teeth. Chaetotaxy of the male front leg as shown on Plate XXXVIII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	105	79	..
Middle leg	100	86	38	25

Unfortunately neither of the two male specimens at my disposal possess complete hind legs.

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest head width nine tenths the pronotal humeral width; five times the anterior width of the vertex; synthlipsis wide, one-half the anterior width of the vertex; along the median longitudinal axis the head is three fifths as long as the pronotum. Pronotum with its humeral width slightly more than twice its median length, lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	123	61	31
Middle leg	100	82	41	27
Hind leg	100	84	34	33

Location of types.—Male holotype, female allotype, one male, two female paratypes, Brisbane, Australia, Dec. 1932, H. Hacker, in the Snow Entomological Museum.

Comparative notes.—This species appears closely related to *Anisops barrenensis* n. sp., only slightly larger and about the same shape. However, the males of *A. hackeri* lack the large swollen front femur as found on *A. barrenensis*, and the second rostral segment does not extend almost the length of the third rostral segment as in the latter species.

Data on distribution.—Known only from type series.

Anisops hyperion Kirkaldy

(Pl. XXXVIII, fig. 16)

1898. *Anisops hyperion* Kirkaldy, Wiener Ent. Zeit., vol. XVII, p. 141.

1904. *Anisops hyperion*, Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 111, 132.

1914. *Anisops hyperion*, Distant, Nova Caledonia, Zoologie, vol. I, p. 386 (ecological note).

1923. *Anisops hyperion*, Hale, South Australian Naturalist, vol. IV, no. 3, pp. 124-128, text fig. 1 (determined in error; actually *Anisops thienemanni* Lundblad).

1923. *Anisops hyperion*, Hale, Rec. South Australian Mus., vol. II, no. 3, pp. 403-412, text fig. 365 (determined in error, actually *Anisops thienemanni* Lundblad).

1924. *Anisops hyperion*, Hale, South Australian Nat., vol. V, no. 4, p. 135 (determined in error; actually *Anisops thienemanni* Lundblad).

1926. *Anisops hyperion*, Esaki, Ann. Mus. Nat. Hungarici, vol. XXIV, p. 188 (ecological data; determination doubtful).

1930. *Anisops hyperion*, Hutchinson, Proc. Zool. Soc. London, vol. XXIX, p. 145, text fig. 2 (determined in error; actually *Antisops thienemanni* Lund.).

1933. *Anisops hyperion*, Lundblad, Archiv. für Hydrobiologie Suppl., vol. XII, p. 145 (a list of the Indo-australian and Pacific forms of this genus).

Size.—Males, length 6.0 mm.-6.5 mm., greatest width of body 1.5 mm.-1.6 mm.; females, length 6.0 mm.-6.6 mm., greatest body width 1.5 mm.-1.8 mm.

Shape.—Fusiform species; greatest body width midway the length of the body.

Color.—General facies stramineous. Eyes brown. Scutellum may be red orange or only have its margins tinged with orange. Legs stramineous. Abonminal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width of the head almost nine tenths the pronotal humeral width and five to six times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is nine tenth the length of the pronotum. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and a slightly more than one half the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised. Labrum with its basal width slightly more than the median length; apex rounded; surface of the labrum provided with a few scattered hairs. Rostral prong (Pl. XXXVIII, fig. 16b) almost as long as the third rostral segment; apex accuminate. Chaetotaxy of the male front leg as shown on Plate XXXVIII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	108	76	..
Middle leg	100	86	41	27
Hind leg	100	85	35	35

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head almost nine tenths the pronotal humeral width and five and one half times the anterior width of the vertex; synthlipsis wide, almost one half the anterior width of the vertex; along the median longitudinal axis the head is two thirds as long as the pronotum with its humeral width at least twice its median length; lateral margins diverging and at least one half the median length; posterior margin convex, medianly

emarginate. The relative lengths of the parts of the legs are as follows:*

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	112	51	36
Middle leg	100	83	39	26

Location of types.—Kirkaldy's type material consisting of two females from Rockhampton, Queensland, Australia in the Hamburg Museum. In the Kirkaldy Collection of the Snow Entomological Collection is a male specimen bearing in Kirkaldy's handwriting the label "hyperion." I am designating this specimen the male allotype. It is from Victoria, Alexandria in Australia.

Comparative notes.—Kirkaldy mentioned in 1904 that possibly he had two species mixed. Such was true, for collected along with *A. hyperion* was a new species which I have named *A. deanei.* These two species are superficially very similar; can best be separated on the character of the male rostral prong, which in *A. deanei* has it dorsal margin extending almost to the apex of the third rostral prong whereas that of *A. hyperion* extends only slightly beyond the basal half of the third rostral segment. Also the apex of the third rostral segment of *A. deanei* is considerably wider than the base of the fourth, whereas in the case of *A. hyperion* the two are approximately the same width.

Data on distribution:

AUSTRALIA

Victoria, Alexandria, F. L. Billinghurst, six males, three females, Kirkaldy Collection (F. H. Snow Coll.)

Anisops tuberculata Poisson

(Pl. XXXVIII, fig. 11; Pl. LVII, fig. 104)

1928. *Anisops tuberculata* Poisson, Bull. Soc. Ent. France, vol. 33, p. 74, text fig. 17.
1929. *Anisops tuberculata,* Poisson, Faune des Colonies Francaises, vol. III, pp. 150-152, text figs. 17, 18, 19.
1948. *Anisops tuberculata,* Poisson, Rev. Francaise Ent., vol. XV, pp. 167-177, (ecological note).

Size.—Males, length 5.5 mm. 6.0 mm., greatest body width 1.6 mm.-1.7 mm.; females, length 5.4 mm.-6.6 mm., greatest body width 1.5 mm.-1.7 mm.

Shape.—Subfusiform species; greatest body width about midway the body length.

Color.—General facies red brown. Hemelytra with hyaline areas which appear black due to the underlying color of the dorsal body

* Unfortunately none of the female specimens at my disposal possessed a complete hind leg.

surface. Legs red brown. Abdominal venter dark brown with keel and segmental margins of the connexivum red brown.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head almost equal to the pronotal humeral width and five to six times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is almost two thirds the length of the pronotum. Pronotum with its humeral width twice the median length; lateral margins diverging and two thirds the median length; posterior margin convex, medianly emarginate; anterior margin between the margins of the eyes bearing a large tubercle. Facial tubercle slightly raised. Labrum with its basal width one and one half the median length; apex rounded. Rostral prong (Pl. LVII, fig. 104) longer than the third rostral segment; apex rounded. Stridulatory comb (Pl. XXXVIII, fig. 11b) highly irregular, apical two teeth large and spatulate. Chaetotaxy of the male front leg as shown on Plate XXXVIII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	105	64	..
Middle leg	100	85	40	37
Hind leg	100	86	33	33

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal humeral width and between five and six times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the length of the pronotum. Pronotum with its humeral width twice its median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	115	51	31
Middle leg	100	85	40	25
Hind leg	100	86	34	34

Location of types.—Type material from Cameron in the Paris Museum.

Comparative notes.—This species, by its large tubercle on the anterior margin of the male pronotum is not readily confused with any other of the genus. However, in general body shape it is similar to *A. debilis*, though it is slightly larger.

Data on distribution:

AFRICA

French Congo, Lake Onango, F. C. Good, Holland Collection, exchange from Carneige Museum, nine males, six females (F. H. Snow Coll.).

Cameron, W. Africa, Samgmelina, IV-16th to 19th-32 five males, one female (F. H. Snow Coll.).

Congo Francaise, N'Gomo, Bas Ogoque, 1906, E. Haug, one male, one female (Paris Museum).

Congo, Ogaque, Sam Kita, 1910, R. Ellenberger, one female (Paris Museum).

Anisops nodulata n. sp.

(Pl. XXXVIII, fig. 14)

Size.—Males, length, 4.6 mm.-4.8 mm., greatest body width 1.2 mm.-1.3 mm.; females, length, 4.8 mm.-5.4 mm., greatest body width 1.3 mm.-1.6 mm.

Shape.—Small fusiform species, with greatest width almost midway the body length.

Color.—General facies stramineous. Eyes brown. Hemelytra may be hyaline and such areas appear black as they overlie the black dorsal body surface. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—View from above, the outline of the head is rounded with its greatest width eight to nine tenths the pronotal humeral width, five times the anterior width of the vertex; synthlipsis wide, slightly more than one third the anterior width of the vertex; along the median longitudinal axis the head is three fourths the pronotal length. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. Facial tubercle flattened and slightly concave. Labrum short; basal width one and two thirds its median length; apex rounded. Rostral prong longer than third rostral segment which is medianly carinate on anterior surface, carina with two nodules (Pl. XXXVIII, fig. 14b). Anterior femur with dorsal and ventral margins almost parallel; apex rounded (Pl. XXXVIII, fig. 14a). Stridulatory comb (Pl. XXXVIII, fig. 14c) of approximately fifteen teeth, longest ones midway between base and apex. Chaetotaxy of male front leg as shown on Plate XXXVIII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	108	80	..
Middle leg	100	87	40	25
Hind leg	100	91	32	28

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width nine tenths the pronotal humeral width, four to four and one half times the anterior width of the vertex; synthlipsis wide, almost one half the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the pronotal length. Pronotum with humeral width slightly more than twice the median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	50	33
Middle leg	100	84	36	29
Hind leg	100	87	30	30

Location of types.—Male holotype, female allotype, four male paratypes, Philippine Islands, Pangasinan, rice fields, 11-19-34, Z. Abalos in the Snow Entomological Collection. Other paratypes are as follows. In the Snow Entomological Collection: two females, Philippine Isl. Dagupan Pangasinan, Sept. 2, 1936, Roman Abalos; two females, Philippine Isl., Baguio, N. T. Prov. Apr. 26, 1936, Roman Abalos; two males, four females, New Guinea, Rigo, 1889, L. Loria.

Comparative notes.—This species is about the same size as *A. exigera* Horvath, from which it differs in having a much wider synthlipsis, front femur of the males rounded and a nodulate carina on the anterior surface of the third rostral segment.

Data on distribution:

Australia

New Queensland, Palm Is. G. F. Hill, one male (Bueno Coll. of F. H. Snow Coll).

Anisops apicalis Stål

(Pl. XXXIX, fig. 17)

1855. *Anisops apicallis* Stål, Ofversigt at Kongl. Vetenskaps-Akademines Fordhandlinger. vol. XII, p. 89.

1865. *Anisops apicalis*, Stål, Hemiptera Africana, vol. III, p. 192.

1904. *Anisops apicalis*, Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 117-118, 132.

1926. *Anisops apicalis*, Jaczewski, Annalibus Zoologicis Musei Polonici Historiae Naturalis, vol. V, No. 2, p. 91, text figs. 50, 51, 52, 53.

1929. *Anisops apicalis*, Hutchinson, Ann. South African Mus., vol. XXV, pp. 406-408, Pl. XXIX, fig. 5; Plate XXX, fig. 21.

1930. *Anisops apicalis*, Hutchinson, Proc. Zool. Soc. London, vol. XXIX, pt. 2, p. 450 (ecological note).

1930. *Anisops apicalis*, Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. VI, p. 59 (ecological note).

1933. *Anisops apicalis*, Jaczewski, Linn. Sci. Jour. Zool., vol. XXXVII, p. 345 (ecological note).

1933. *Anisops apicalis*, Hutchinson, Internat. Rev. ges. Hydrob. Hydrog., vol. 28. pt. 5/6, p. 446.

1948. *Anisops apicalis*, Poisson, Mem. Inst. Scient. Madagascar, Ser. X, vol. I, p. 108 (ecological note).

Size.—Males, length 4.8 mm., greatest body width 1.4 mm.; females, length 4.5 mm., greatest body width 1.6 mm.

Shape.—Small, robust, fusiform species with greatest body width slightly before the middle of the body.

Color.—General facies stramineous. Eyes dark brown. Hemelytra with a subapical transverse brown band. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head equal to the pronotal humeral width and five and one half times the anterior width of the vertex; synthlipsis wide, slightly more than one third the anterior width of the vertex; along the median longitudinal axis the head is slightly more than two thirds the length of the pronotum. Pronotum with its humeral width almost twice its median length; lateral margins almost parallel only slightly diverging, three fifths the median length; posterior margin almost straight. Scutellum greatly reduced; basal width one and three fourths the median length. Wings greatly reduced and appear nonfunctional. Facial tubercle flat with lateral margins posterior to the eyes converging. Labrum narrow and long; median length one and one third its basal width; apex rounded. Rostral prong (Pl. XXXIX, fig. 17b) equal to the length of the third rostral segment; apex more or less rounded. Anterior leg (Pl. XXXIX, fig. 17a) with dorsal and ventral femoral margins almost parallel, apex truncate; stridulatory comb (Pl. XXXIX, fig. 17c) of approximately nineteen long slender teeth which decrease in length at the apex. Chaetotaxy of the male front leg as shown on Plate XXXIX. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	119	79	..
Middle leg	100	81	33	28
Hind leg	100	95	36	35

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head slightly less than the humeral width of the pronotum and almost five and one half times the anterior width of the vertex; synthlipsis wide, slightly more than one third the anterior width of the vertex; along the

median longitudinal axis the head is as long as the pronotum. Pronotum short with its humeral width slightly more than three times its median length; lateral margins only slightly diverging and two thirds the median length; posterior margin straight. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	112	55	36
Middle leg	100	87	39	28
Hind leg	100	97	25	25

Location of types.—Type material from Caffraria in the Stockholm Museum.

Comparative notes.—This species appears very similar to *Anisops hungerfordi* Poisson from which it can be separated on the basis of the scutellum which is greatly reduced in *A. apicalis,* basal width one and three fourths its median length; whereas in *A. hungerfordi* the basal width is only one and two sevenths the median length. Also the wings of the latter species are not brachypterous.

Data on distribution:

AFRICA

Ugando, Entebbe, VIII-4-1929, G. H. E. Hopkins, gift to H. B. Hungerford from G. E. Hutchinson, one male, one female (F. H. Snow Coll.).

Afrique Orient. Angl., Zanzibar, Riviera Mivera, 1904, Ch. Alluaud, one male (Paris Museum).

Anisops caneriensis perplexa Poisson

(Pl. XXXIX, fig. 20)

1929. *Anisops perplexa* Poisson, Bull. Soc. Hist. Nat. Afrique du Nord, vol. XX. pp. 87-89, figs. 1, 2, 3, 113.

1933. *Anisops perplexa,* Hutchinson, Internat. ges. Hydrob. und Hydrog., vol. 28, pt. 5/6, p 452 (ecological note).

1934. *Anisops perplexa,* Poisson, Bull. Soc. Hist. Nat. Afrique du Nord, vol. XXV, pp. 135-137.

1948. *Anisops canariensis perplexa,* Poisson, Inst. Rech. Sahar. Univ. D'Alger, p. 5. text figs. 14, a, c. (Places *A. perplexa* as a subspecies of *A. canariensis* Noualhier.)

Size.—Males, 6.0 mm., greatest body width 1.5 mm.; females, length 5.9 mm.-6.3 mm., greatest body width 1.5 mm.-1.6 mm.

Shape.—Slightly fusiform species; greatest body width about midway the length of the body.

Color.—General facies stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the anterior margin almost straight; greatest width of the head almost equal to the pronotal humeral width and almost six times the anterior width of the vertex; synth-

lipsis wide, slightly more than one third the anterior width of the vertex; along the median longitudinal axis the head is eight tenths the pronotal length. Pronotum with its humeral width almost twice the median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly concave. Facial tubercle slightly raised. Labrum short, basal width one and one half the median length. Rostral prong (Pl. XXXIX, fig. 20b) longer than the third rostral segment; apex accuminate. Stridulatory comb (Pl. XXXIX, fig. 20c) of approximately twenty-three teeth which decrease slightly in length from base to apex. Chaetotaxy of the male front leg as shown in Plate XXXIX. The relative lengths of the parts of the legs are as follows:*

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	115	78	..
Middle leg	100	86	38	25

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head nine tenths the pronotal humeral width and slightly more than five times the anterior width of the vertex; synthlipsis wide, one half the anterior width of vertex; along the median longitudinal axis the head is three fifths the length of the pronotum. Pronotum with its humeral width slightly more than twice the median length; lateral margins of the pronotum diverging and three fifths the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	121	54	31
Middle leg	100	78	37	22
Hind leg	100	78	28	28

Location of types.—Type material from Algeria is in Poisson's Collection.

Comparative notes.—This subspecies differs from *A. canariensis canariensis* by the fact that the anterior tarsi of the males have a median row of four small setae in the basal half of the inner surface. It is remarkably similar to *A. debilis* Gerst. and differs from it primarily by the width of the synthlipsis which is one third the anterior width of the vertex instead of one sixth the anterior width of the vertex as in *A. debilis.*

* Hind legs on two male specimens in my material missing.

Data on distribution:

AFRICA

Algerie, S. Culomb-Bachae, 1912; P. Germain, one male, one female in the F. H. Snow Collection, fourteen males in the Paris Museum.

Tripolitaine, Marais de Tadjouran, Pres de Tripoli, 1901, Ch. Alluaud, one male (Paris Museum).

Anisops edepol Kirkaldy

(Pl. XXXIX, fig. 19; Pl. LIV, fig. 94)

1899. *Anisops edepol* Kirkaldy, Ann. Soc. Ent. France. vol. LXVIII, p. 107.

1904. *Anisops edepol*, Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 119, 132. Referring also to this species:

1899. *Anisops erebus*, Kirkaldy, Ann. Soc. Ent. France, vol. LXVIII, pp. 107-108.

1904. *Anisops erebus*, Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 119-132.

1948. *Anisops erebus*, Poisson, Mem. Inst. Sci. Madagascar, Ser. A, vol. 1, text fig. 18, p. 109. (Poisson mentions that the male of the species has not been described.)

1906. *Anisops Kirkaldyanus*, Bergroth, Wiener Ent. Zeit., vol. XXV, pp. 112 (Bergroth proposes the name *Kirkaldyanus* for *edepol*).

Size.—Males, length 4.5 mm.-4.8 mm., greatest body width 1.6 mm.-1.8 mm.; females, length 5 mm.-5.5 mm., greatest body width 1.8 mm.-2.1 mm.

Shape.—Small, robust fusiform species, greatest body width about two fifths the body length.

Color.—Brown form: General facies stramineous. Eyes brown. Legs stramineous. Abdominal venter dark brown with keel and segmental margins stramineous. *Dark form*: General facies black. Eyes brown. Vertex, pronotum flavus. Hemelytra hyaline and appear black due to the underlying black body surface. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with its greatest width nine tenths the pronotal humeral width and six times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior width of the vertex; along the median longitudinal axis the head is only slightly shorter than the length of the pronotum. Pronotum with its humeral width over twice its median length; lateral margins only slightly diverging and over one half the median length; posterior margin straight. Facial tubercle swollen and bearing a median, short, ventrally directed spur. Labrum very short; basal width one and one half the median length; apex rounded. Rostral prong (Pl. LIV, fig. 94) short and narrow; shorter than third rostral segment; apex rounded. Stridulatory comb (Pl. XXXIX,

fig. 19b) of approximately seven teeth which increase in length from base to apex. Chaetotaxy of the male front leg as shown on Plate XXXIX. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	135	85	..
Middle leg	100	85	35	30
Hind leg	100	90	25	25

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head eight tenths the pronotal humeral width and five times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior width of the vertex; along the median longitudinal axis the head is slightly more than half the length of the pronotum. Pronotum with its humeral width slightly more than twice the median length; lateral margins only slightly diverging and slightly more than one half the median length; posterior margin straight. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	131	55	42
Middle leg	100	85	40	30
Hind leg	100	93	30	30

Location of types.—Part of the type material from Madagascar in the Paris Museum. One male and one female cotype (exchange from Paris Museum) in the F. H. Snow Collection. The female type of *A. erebus* Kirkaldy in the F. H. Snow Collection.

Comparative notes.—The robustness and small size of this species makes it appear superficially similar to *A. apicalis* Stål. However the males of *A. edepol* lack the apically enlarged front femur with its truncate apex as found on the males of *A. apicalis.* Also the male facial tubercle of the latter species is not swollen and bearing the short projection as on *A. edepol.* The wings of *A. edepol* are not brachypterous.

Remarks: I was fortunate in having at my disposal the female type of *A. erebus* and a male and female cotype of *A. edepol.* Examination of the two groups showed immediately that they were identical. Therefore I am placing *A. erebus* as a synonym of *A. edepol* as the latter has page priority.

Data on distribution:

MADAGASCAR

Madagascar, P. Camboue, one male, one female (co-types) (F. H. Snow Coll.).

Tananarive, 1921, R. Decary, one male, one female (Paris Museum).

Region du Sud-est, Vallee du Fanjakira Isaka, 1901, Ch. Alluaud, one male, one female (Paris Museum).

Maroantsetra, purchased fr. Dr. O. Standinger, two females (F. H. Snow Coll.).

Diego-Suarez, 1893, Ch. Alluaud, one female (type of *A. crebus*) (F. H. Snow Coll.).

Anisops timorensis n. sp.*

(Pl. XXXIX, fig. 18)

Size.—Male, length 5.4 mm., greatest body width 1.5 mm.

Shape.—Small, subfusiform species, lateral margins in posterior half of body converging, those of anterior half almost parallel.

Color.—General facies gray. Eyes gray brown. Vertex, pronotum, and scutellum testaceous; pronotum mostly hyaline and appearing black as it overlies the black anterior margin of the scutellum. Hemelytra, with claval margins tinged with crimson; remainder hyaline and appearing dark gray as it overlies the black dorsal body surface. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with anterior margin almost straight; greatest width of head nine tenths the pronotal humeral width, slightly more than five times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is three fifths the pronotal length. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and three fifths the median length; posterior margin convex, medianly emarginate. Facial tubercle only slightly raised. Labrum moderately long, median length equal to its basal width; apex rounded. Rostral prong (Pl. XXXIX, fig. 18b) with apex accuminate. Basal half of third rostral segment covered with an extension of the second rostral segment along its posterior margin. Front femur (Pl. XXXIX, fig. 18a) with apex rounded. Stridulatory comb (Pl. XXXIX, fig. 18c) of approximately twenty-four teeth. Chaetotaxy of the male front leg as shown on Plate XXXIX. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	111	83	..
Middle leg	100	77	45	23
Hind leg	100	83	35	35

Location of types.—Male holotype, Baguia, Timor, in the Basel Naturhistorisches Museum in Switzerland.

Comparative notes.—Though much smaller, it is very similar in

* Only a single male specimen available for study.

general appearance to *A. occipitalis* Breddin. However the males of the latter lack the extension of the second rostral segment along the third rostral segment as found on the male of *A. timorensis*. For comparison of the chaetotaxies of the front legs of the males of the two see Plate XXXIX, fig. 18a and Plate XXXIX, fig. 22a.

Data on distribution.—Known only from type locality.

Anisops occipitalis Breddin

(Pl. XXXIX, fig. 22)

1905. *Anisops occipitalis* Breddin, Mitteil. Naturh. Mus. Hamburg, vol. XX, p. 152.
1933. *Anisops occipitalis*, Lundblad, Arch. für Hydrob., Suppl. vol. XII, pp. 145, 158-160, text fig. 154.

Size.—Males, length 6.6 mm.-7.2 mm., greatest body width 1.9.-2.1 mm.; females, length 6.6 mm.-7.2 mm., greatest width of body 1.6 mm.-2.1 mm.

Shape.—Robust, slightly fusiform species; lateral margins in anterior half of body only slightly converging.

Color.—General facies stramineous or testaceous. Scutellum may be testaceous, black, or black only on apical half, posterior half testaceous or stramineous. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the head is broad, with its outline rounded; greatest width of head eight to nine tenths the pronotal width and six and one half times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertev; along the median longitudinal axis the head is slightly more than two thirds the length of the pronotum. Pronotum with its humeral width two and one half times its median length; lateral margins diverging and about two thirds the median length; posterior margin convex, medianly emarginate. Facial tubercle only slightly raised. Labrum with its basal width slightly more than its median length; apex rounded; covered with short procumbent hairs. Rostral prong (Pl. XXXIX, fig. 22b) equal to or slightly longer than the third rostral segment; apex accuminate. Stridulatory comb (Pl. XXXIX, fig. 22c) of about twenty teeth which decrease in width from base to apex. Chaetotaxy of the front leg as shown on Plate XXXIX. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	111	73	..
Middle leg	100	76	40	24
Hind leg	100	82	29	27

Female structural characteristics.—Viewed from above, the outline of the head is rounded with its greatest width eight to nine tenths the pronotal humeral width and five to six times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior width of the vertex; along the median longitudinal axis the head is two thirds the length of the pronotum. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and two thirds the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	113	50	29
Middle leg	100	77	38	23
Hind leg	100	81	29	29

Location of types.—Breddin's type female from Buitenzorg, Java, in the Hamburg Museum.

Comparative notes.—Very similar in size and general appearance to *Anisops leucothea* Esaki from which it can best be distinguished on the basis of the males. The male of *A. leucothea* have the greatest width of the head equal to the pronotal humeral width and the lateral margins of the pronotum are almost parallel whereas in this species the greatest width of the head is about nine tenths the pronotal humeral width and the lateral margins of the pronotum are diverging.

Data on distribution:

JAVA

Buitenzorg, Apr. to Dec. 1896, D. G. Fairchild, fifteen males, fourteen females, Kirkaldy Collection (F. H. Snow Coll.).

Buitenzorg, 1875, G. B. Ferrari, one female, Kirkaldy Collection (F. H. Snow Coll.).

NEW GUINEA

Port Moresby, Guigno, 1889, L. Loria, two males, three females, Kirkaldy Collection (F. H. Snow Coll.).

Rigo, Luglio, 1889, L. Loria, seventeen males, eleven females, Kirkaldy Collection (F. H. Snow Coll.).

NEW CALEDONIA

Noumea, A. Fauvel, one male, Kirkaldy Collection (F. H. Snow Coll.).

AUSTRALIA

Sir Graham Moore Id. II-20-1945, B. Malkin, two males, one female (U. S. Nat. Mus.).

Barren River nr. Barren Waters, IX-2-38, R. G. Wind, one male (F. H. Snow Coll.).

Anisops coutierei n. sp.

(Pl. XXXIX, fig. 21)

Size.—Males, length 5.4 mm.-5.8 mm., greatest body width 1.4 mm.-1.6 mm.; females, length 5.8 mm.-6.8 mm., greatest body width 1.5 mm.-1.8 mm.

Shape.—Subfusiform species; greatest body width about midway the body length.

Color.—General facies testaceous. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal humeral width and five to six times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is one half the pronotal length. Pronotum with its humeral width twice its median length; lateral margins diverging, almost three fifths the median length; posterior margin convex, medianly emarginate. Facial tubercle only slightly raised. Labrum short and broad; basal width one and one half the median length; apex rounded. Rostral prong (Pl. XXXIX, fig. 21b) longer than the third rostral segment; apex acuminate. Stridulatory comb, (Pl. XXXIX, fig. 21a) of approximately twenty teeth, decreasing slightly in length at apex. Chaetotaxy of the male front leg as shown on Plate XXXIX. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	108	72	..
Middle leg	100	85	40	25
Hind leg	100	79	32	32

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head nine tenths the pronotal humeral width and five to six times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is three fifths the length of the pronotum. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and three fifths the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	114	51	36
Middle leg	100	83	38	25
Hind leg	100	77	30	30

Location of types.—Male holotype, female allotype, one male and one female paratypes Africa, Djibouti, 1897, H. Coutiere, in the Paris Museum. Two male and two female paratypes (same collection data as above) in the F. H. Snow Collection.

Comparative notes.—Very closely related to *Anisops debillis* Gerst. from which it can be distinguished by its wider synthlipsis which is one half the anterior width of the vertex instead of one fifth the anterior width of the vertex. Also the male front femur is slightly rounded at the apex whereas in *A. debilis* it is accuminate.

Data on distribution.—Known only from type series.

Anisops pellucens Gerstaecker

(Pl. XL, fig. 26)

1873. *Anisops pellucens* Gerstaecker, Decken's Reise in Ost Africa III, pt. 2, pp. 424-425.

1929. *Anisops pellucens*, Hutchinson, Ann. South African Mus., vol. XXV, pt. 2, pp. 384-385, Pl. XXIX, fig. 2; Pl. XXX, fig. 10; Pl. XXXI, fig. 2.

1930. *Anisops pellucens f. pellucens*, Hutchinson, Proc. Zool. Soc. London, vol. XXIX, pt. 2, p. 445.

1930. *Anisops pellucens f. splendida*, Hutchinson, Proc. Zool. Soc. London, vol. XXIX, pt. 2, p. 445.

1930. *Anisops pellucens f. pellucens*, Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. VI, pp. 57-58 (ecological note).

1933. *Anisops pellucens*, Jaczewski, Linn. Soc. Jour., Zool., vol. XXXVIII, p. 345.

1937. *Anisops pellucens*, Poisson, Ann. Soc. Ent. France, vol. CVI, p. 118, fig. 5 (discusses the color forms of Hutchinson).

1937. *Anisops pellucens f. rubroscutellata*, Poisson. (*loc. cit.*), p. 119.

1937. *Anisops pellucens f. grandis*, Poisson, (*loc. cit.*), p. 120. (I have raised this to specific level.)

1940. *Anisops pellucens f. pellucens*. Poisson, Bull. Mus. Royal Hist. Nat. Belgique, vol. XVII, no. 29, p. 19, (ecological note).

1941. *Anisops pellucens*, Poisson, Rev. Franc. Ent., vol. VIII, p. 97, (ecological note).

1948. *Anisops pellucens f. pellucens*, Poisson, Mem. Inst. Sci. Madagascar, Ser. A, vol. I, pt. 2, p. 108 (ecological note).

Referring to this species also:

1899. *Anisops nivea*, Kirkaldy, Ann. Soc. Ent. France, vol. LXVIII, p. 105 (determined in error).

1901. *Anisops nivea*, Kirkaldy, The Entomologist, vol. XXXIV, p. 5, (determined in error).

1904. *Anisops nivea*, Kirkaldy, Wiener Ent. Zeit., vol. XXIII, p. 119, 132 (determined in error).

1908. *Anisops nivea*, Kirkaldy, Sjostedt: Wissenschaften Ergebn. der Schwed. Zool. Exped., Hemiptera, vol. XII, p. 24 (determined in error).

1928. *Anisops nivea*, Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. I, p. 164 (determined in error).

1929. *Anisops nivea*, Poisson, Faune des Colonies Francaise, vol. III, pp. 154-155, text fig. 22.

1898. *Anisops ciliata*, Kirkaldy, Ann. Mus. Civ. Stor. Nat. Genova, vol. XXIX (determined in error).

1892. *Anisops scutellaris*, De Carlini, Ann. Mus. Civ. Stor. Nat. Genova Ser. 2, vol. XII (XXXII), p. 11 (determined in error; no description given, only size; probably this species).

1895. *Anisops scutellaris*, De Carlini, (*loc cit.*), vol. XXXV, p. 19 (determined in error; no description given, only size; probably this species).

Size.—Males, length 9.0 mm.-9.6 mm., greatest body width 2.4 mm.-2.8 mm.; females, length 9.6 mm.-9.9 mm., greatest body width 2.2 mm.-2.7 mm.

Shape.—Large fusiform species, widest about midway the length of the body.

Color.—General facies stramineous or gray. Eyes brown. Scutellum may be red with anterior margin black, entirely red or testaceous, or entirely black. Hemelytra gray or stramineous and hyaline and appear darker due to the underlying darker dorsal body surface. Legs stramineous. Abdominal venter brown or dark brown with keel and segmental margins of the connexivum testaceous or stramineous. The latter may be tinged with red.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head eight to nine tenths the pronotal humeral width and six times the anterior width of the vertex; synthlipsis wide, one half or more the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the length of the pronotum. Pronotum with its humeral width almost twice its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised with a few, small scattered hairs. Labrum short and broad; basal width one and eight tenths the median length. Rostral prong (Pl. XL, fig. 26b) slightly shorter than the third rostral segment; apex more or less blunt. Stridulatory comb (Pl. XL, fig. 26c) of approximately twenty-two teeth which increase slightly in length from the base to the apex. Chaetotaxy of the front leg as shown on Plate XL. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	80	..
Middle leg	100	87	38	25
Hind leg	100	80	30	28

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head eight tenths the pronotal humeral width and five to six times the anterior width of the vertex; synthlipsis wide, almost two thirds the anterior width of the vertex; along the median longitudinal axis the head is approximately one half the length of the pronotum. Pronotum with its humeral width slightly more than twice the median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	117	50	25
Middle leg	100	90	37	25
Hind leg	100	77	27	27

Location of types.—Gerstaecker's type material in the Berlin Museum.

Comparative notes.—This species along with *Anisops letitia* Hutchinson is the largest known species from the African mainland. Though only slightly larger than *A. letitia* it can be readily distinguished from it by the fact that the latter species has the posterior margin of the pronotum convex and not medianly emarginate, as in *A. pellucens.*

Data on distribution:

Africa

Angola, St. Paul de Loando, two females (U. S. Nat. Mus.).

St. Paul, two females (F. H. Snow Coll.).

?—Paru, one male (F. H. Snow Coll.).

East Africa, IV-28-1948, F. X. Williams (Harv. Mus. Comp. Zool.).

Tanganyika Terr. Amani, Feb. 1948, F. X. Williams, two males, two females (F. H. Snow Coll.), four males, twelve females (Harv. Mus. Comp. Zool.).

Reg. de Zinder, Dungass, Mission Tikho, 1910, Dr. R. Gaillard, one female (Paris Museum).

Abyssinia, Plaine Danakil, Maro, 1903, Dr. J. Rogers, one female (Paris Museum).

Souden-Egyptian, Roseires, Haut Nil Bleu, 1907, Ch. Alluaud, one male, one female (Paris Museum).

Senegal, one male (Paris Museum).

Africa Orient. Anglo, Kisoumou, Victoria-Kyanza, 1904, Ch. Alluaud, two males, five females (Paris Museum).

Belgium Congo: Eala, XI-1935, J. Ghesquiere, three females (Belgium Museum).

South Africa: Belagoa, Coll. Juond., one male (Basel. Nat. Hist. Mus. Switzerland).

Anisops malkini n. sp.*

(Pl. XL, fig. 23)

Size.—Male, length 6.9 mm.; greatest body width 1.6 mm.

Shape.—Fusiform species with greatest width about midway the body length.

Color.—General facies stramineous. Eyes brown. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head nine tenths the pronotal humeral width, five to six times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior width of the vertex; along the median longitudinal axis the head is three fourths the pronotal length. Pronotum with its humeral width

* Only one male specimen was available for study.

almost twice its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. Frons depressed and flat, terminated by a transverse ridge at its apex. Labrum short, with the basal width one and one fifth its median length; apex rounded. Rostral prong (Pl. XL, fig. 23b) slightly shorter than the third rostral segment; apex accuminate. Stridulatory comb (Pl. XL, fig. 23c) of about fifteen teeth with the longest midway between the base and apex. Chaetotaxy of the front leg as shown on Plate V. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	68	..
Middle leg	100	84	40	22
Hind leg	100	82	..	..

Unfortunately, the first and second tarsal segments of the hind legs were lacking.

Location of types.—Male holotype, Darwin NT, Australia, III-25-45, B. Malkin, in the United States National Museum.

Comparative notes.—Though much larger than *Anisops crinita* n. sp., this species has the flattened frons as possesed by *A. crinita.* There is no danger of confusing the two for in addition to the size difference, *A. malkini* does not have the hairy frons of *A. crinita* and also the chaetotaxies of the front legs of the males is decidedly different.

Data on distribution: Known only from type locality.

Anisops evansi n. sp.

(Pl. XLI, fig. 27)

Size.—Males, length 6.9 mm., greatest body width 1.6 mm.; females, length 6.7 mm., greatest body width 1.4 mm.

Shape.—Fusiform, broadheaded species; greatest body width midway the body length.

Color.—General facies gray. Eyes brown. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the vertex extending slightly beyond the anterior margin of the eyes; greatest width of the head slightly more than the pronotal humeral width, slightly more than six times the anterior width of the vertex; synthlipsis wide, three fourths the anterior width of the vertex; along the median longitudinal axis the head is slightly shorter than the pronotum. Pronotum with its

humeral width approximately one and five sevenths its median length; lateral margins almost parallel only slightly diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. Facial tubercle flat, only slightly raised. Labrum short with long hairs arising at base and extending almost the length of the labrum; basal width one and one third the median length; apex rounded, almost truncate. Rostral prong (Pl. XLI, fig. 27b) shorter than third rostral segment; apex accuminate. Stridulatory comb (Pl. XLI, fig. 27c) of approximately twenty teeth, basal seven longer than the apical thirteen. Chaetotaxy as shown on Plate XLI. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	133	86	..
Middle leg	100	81	34	22
Hind leg	100	78	32	32

Female structural characteristics.—Viewed from above, the outline of the head is more or less conical with the vertex extending slightly beyond the anterior margins of the eyes; greatest width of head nine tenths the pronotal humeral width, four times the anterior width of the vertex; synthlipsis wide, two thirds the anterior width of the vertex; along the median longitudinal axis the head is slightly more than two thirds the pronotal length. Pronotum with its humeral width twice its median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	131	56	31
Middle leg	100	88	38	23
Hind leg	100	83	30	30

Location of types.—Male holotype, female allotype, Tasmania, Lake Dakerton, II-1940, J. W. Evans, in the Snow Entomological Collection.

Comparative notes.—Though slightly smaller than *Anisops tasmaniaensis* n. sp., *A. evansi* appears closely related to it. The males of the two species serve as a ready means of separation for that of the latter has the head wider than the pronotum whereas in the former the head is at most only equal to the pronotal width. Also the males of *Anisops tasmaniaensis* lack the long hairs as found on the labrum of *A. evansi.* For comparison of the chaetotaxies of the front legs of the males see Plate XLI, fig. 27a, and Plate XLVII, fig. 58a.

Data on distribution.—Known only from type series.

Anisops gratus Hale

(Pl. XLII, fig. 31)

1923. *Anisops gratus* Hale, Rec. South Australian Mus. vol. II, no. 3, pp. 413-414, text fig. 369.

1933. *Anisops gratus*, Lundblad, Archiv für Hydrob., Suppl. vol. XII, p. 145 (a list of Indo-australian and Pacific forms of this genus).

Size.—Males, length 7.2 mm.-7.8 mm., greatest body width 1.9 mm.-2.1 mm.; females, length 7.2 mm.-7.8 mm., greatest body width 1.9 mm.-2.1 mm.

Shape.—Fusiform species; greatest body width about midway the body length.

Color.—General facies stramineous or testaceous. Eyes brown. The testaceous areas are often tinged with orange on the scutellum. Legs stramineous. Abdominal venter testaceous or stramineous with irregular brown areas appearing on each sternite.

Male structural characteristics.—Viewed from above, the outline of the head is rounded, with the anterior margin of the head almost straight; greatest width of head nine tenths the pronotal humeral width and four to five times the anterior width of the vertex; synthlipsis wide, approximately one third the anterior width of the vertex; along the median longitudinal axis the head varies from almost one half to one half the length of the pronotum. Pronotum with its humeral width almost twice its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate; dorsal surface with a median longitudinal depression. Facial tubercle only slightly raised. Labrum with its basal width one and one fifth its median length; apex rounded. Rostral prong (Pl. XLII, fig. 31b) longer than the third rostral segment; apex accuminate. Stridulatory comb (Pl. XLII, fig. 31c) of approximately sixteen teeth. Chaetotaxy of the front leg as shown on Plate XLII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	111	65	..
Middle leg	100	73	35	20
Hind leg	100	85	37	37

Female structural characteristics.—Viewed from above, the outline of the head is rounded with the vertex extending slightly beyond the anterior margins of the eyes; greatest width of the head eight tenths the pronotal humeral width and three to four times the anterior width of the vertex; synthlipsis wide, slightly more than one third the anterior width of the vertex; along the median longitudinal

axis the head is almost one half the pronotal length. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and eight tenths the median length; posterior margin convex, medianly emarginate, dorsal surface with the same median depression as found on the males. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	118	50	27
Middle leg	100	89	41	22
Hind leg	100	45	38	38

Location of types.—Type material, Broken Hill, New South Wales, Australia, F. W. Shepherd in the South Australian Museum. Two male, and four female cotypes, Broken Hill, New South Wales, Australia, Fred W. Shepherd in the Snow Entomological Collection.

Comparative notes.—This species is of about the same size as *A. doris* Kirk. but the males lack the broad rounded head and the narrow anterior width of the vertex as found on the males of *A. doris*. For comparison of the chaetotaxies of the front legs of the males see Pl. XLII, fig. 31a and Pl. XLVI, fig. 53a.

Data on distribution:

AUSTRALIA

New South Wales, Broken Hill, Fred W. Shepherd, three females (F. H. Snow Coll.).

New South Wales, Broken Hill, in nine mile dam, IV-23-44, C. E. Chadwick, one male, five females (Dept. of Agric., N. S. W., Austrl.).

New South Wales, Broken Hill, IV-10-44, C. E. Chadwick, nine females (Dept. of Agric. N. S. W., Austrl.).

New South Wales, Broken Hill, 1944, C. E. Chadwick, two females (Dept. of Agric. N. S. W., Austrl.).

New South Wales, Imperial Dam, XII-31-1925, F. W. Shepherd, thirty-two males, eleven females (F. H. Snow Coll.).

Bordertown, one female (F. H. Snow Coll.).

Sir Graham Moore Id. II-20-45, B. Malkin, two females (F. H. Snow Coll.).

Anisops gobana Poisson

(Pl. XLI, fig. 28)

1940. *Anisops gobana* Poisson, Bull. Mus. Roy. Hist. Nat. Belgique, vol. XVI, no. 27, pp. 10-12, text figs. 13-16.

Size.—Males, length 6.9 mm. greatest body width 2.1 mm.; females, length 7.2 mm., greatest body width 2.1 mm.

Shape.—Subfusiform species; lateral margins almost parallel in anterior half, converging in posterior half.

Color.—General facies black. Eyes brown. Vertex and pronotum stramineous, the latter with a faint dark brown median longi-

tudinal stripe. Scutellum black, with lateral margins testaceous. Hemelytra hyaline and appears black due to the black dorsal body surface, margins bordering scutellum and hemelytral commissure red. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal humeral width and slightly more than four times the anterior width of the vertex; synthlipsis wide, slightly more than one third the anterior width of the vertex; along the median longitudinal axis the head is three fifths the length of the pronotum. Pronotum with humeral width slightly more than twice the median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised. Labrum long, median length equal to basal width; apex more or less accuminate. Rostral prong (Pl. XLI, fig. 28b) shorter than the third rostral segment; apex accuminate. Stridulatory comb (Pl. XLI, fig. 28c) of approximately eight teeth. Chaetotaxy of the male front leg as shown on Plate XLI. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	125	90	..
Middle leg	100	81	39	23
Hind leg	100	80	42	(lacking)

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head eight tenths the pronotal humeral width and slightly more than four times the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one third the length of the pronotum. Pronotum with its humeral width slightly more than twice the median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	125	86	37
Middle leg	100	80	40	25
Hind leg	100	82	37	37

Location of types.—Type material, Ethiopia, Cuba, 1934-1935, R. de Meulenaere, in the Royal Museum of Natural History in Brussels, Belgium. One male and one female paratypes (same collection data as above) in the F. H. Snow Entomological Collection.

Comparative notes.—This species is very similar in general ap-

pearance to *Anisops varia* Fieber. However, the synthlipsis is narrower, being about one third the anterior width of the vertex instead of one half as in *A. varia*. Also the head is slightly narrower in this species, only eight tenths the pronotal humeral width instead of nine tenths as found on *A. varia*.

Data on distribution.—Known only from type series.

Anisops varia Fieber

(Pl. XLII, fig. 32)

1851. *Anisops varius* Fieber, Abhand. Kongl. Boh. Gesell. Wiss., vol. V, pt. 7, pp. 483-484.

1851. *Anisops various* f. *sugillata*, Fieber, (*loc. cit.*), p. 483.

1851. *Anisops varius* f. *scutellata*, Fieber, (*loc. cit.*), p. 483.

1853. *Anisops varius*, Herrich-Shaffer, Die Wanzenartigen Insecten, vol. IX, p. 10 (list of the species of *Anisops*).

1888. *Anisops varius*, Horvath, Rev. Ent., vol. VII, p. 189 (= *Notonecta nanula* Walker).

1899. *Anisops varius*, Kirkaldy, Ann. Soc. Ent. France, vol. LXVIII, p. 106 (= *Anisops perpulcher* Stal).

1899-1900. *Anisops varia*, Puton, Rev. Ent., vol. LXVIII, p. 80.

1904. *Anisops varia*, Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 119, 132.

1905. *Anisops varius*, Distant, Trans. Linn. Soc. London, vol. XIII, pt. I, p. 38 (ecological note).

1910. *Anisops varius*, Distant, Fauna of British India, vol. V, p. 332 (ecological note).

1922. *Anisops varia*, Lindberg, Notulae Entomologicae, vol. II, p. 47, text fig. 3.

1926. *Anisops varius*, Esaki, Ann. Mus. Nat. Hungarici, vol. XXIV, p. 188 (ecological note).

1926. *Anisops varia*, Jaczewski, Ann. Mus. Polonici Hist. Nat., vol. XXIV, p. 188 (ecological note).

1928. *Anisops varia*, Dover, Treubia, vol. 10, p. 71 (ecological note).

1929. *Anisops varia*, Hutchinson, Ann. South African Mus., vol. XXV, pp. 393-400, Pl. XXX, fig. 17; Pl. XXXII, fig. 2 (says the *A. perpulcher kalahariensis* Schumacher and *A. perpulcher plumbeus* Schumacher are general forms).

1929. *Anisops varia varia*, Hutchinson, Ann. South African Mus., vol. XXV, p. 399 (= *A. varia sugillata* Fieber).

1929. *Anisops varia scutellata*, Hutchinson, Ann. South African Mus., vol. XXV, p. 399 (= *A. perpulcher* Stål).

1930. *Anisops varia varia*, Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. VI, p. 58 (ecological note).

1932. *Anisops varia varia*, Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. IV, p. 324 (ecological note).

1933. *Anisops varia*, Hutchinson, Internat. Revue der ges. Hydrob. Hydrog., vol. 28, pt. 5/6, p. 438 (ecological note).

1933. *Anisops varia*, Lundblad, Arch. für Hydrob., Suppl. vol. XII, p. 146 (list of Indo-australian and Pacific members of this genus).

1935. *Anisops varia varia*, Poisson, Mus. Nat. Hist. Nat., vol. III, p. 208 (ecological note).

1936. *Anisops varia*, Jaczewski, Ann. Zool. Musei Polonici, vol. XI, p. 201 (ecological note).

1939. *Anisops varia varia*, Poisson, Bull. Soc. Ent. France, vol. 44, p. 42 (ecological note).

1948. *Anisops varia varia*, Poisson, Inst. Rech. Sahar. Univ. Alger, p. 7 (ecological note).

1948. *Anisops varia scutellata*, Poisson, (loc. cit.), p. 7 (ecological note).

Referring to this species also:

1858. *Anisops perpulcher*, Stål, Ofver. Kongl. Vetensk. Akad. Fordhandl., vol. XX, p. 89.

1869. *Anisops perpulcher*, Stål, Hemiptera Africana III, p. 192.

1892. *Anisops perpulcher*, De Carlini, Ann. Mus. Stor. Nat. Genova, Series 2a, vol. XII, (XXXII), p. 11, (ecological note).

1913. *Anisops perpulcher*, Schumacher, Denksch. der Medic. Ges. Jena, vol. 17, p. 83.

1913. *Anisops perpulcher plumbeus*, Schumacher, (*loc. cit.*), p. 83 (determined in error).

1913. *Anisops perpulcher kalahariensis*, Schumacher, (*loc. cit.*) p. 83 (determined in error).

1925. *Anisops perpulcher*, Hesse, Ann. South African Mus., vol. XXII, p. 137 (determined in error).

1929. *Anisops hoggarica*, Poisson, Bull. Soc. Hist. Nat. Afrique du Nord, vol. XX, pp. 89-91, text figs. 4, 5, 6 (determined in error).

1933. *Anisops hoggarica*, Hutchinson, Internat. ges. Hydrob. Hydrog., vol. 28, pt. 5/6, p. 453 (ecological note).

1934. *Anisops hoggarica*, Poisson, Mem. Soc. Hist. Nat. Afrique du Nord, vol. 4, pp. 137-139, text figs. 4, 5, 6 (determined in error).

1939. *Anisops hoggarica*, Poisson, Bull. Soc. Ent. France, vol. 44, p. 43 (ecological note)

1941. *Anisops hoggarica*, Poisson, Rev. Francaise Ent., vol. VIII, p. 77 (ecological note).

1948. *Anisops varia hoggarica*, Poisson, Inst. Recher. Sahar. Univ. d'Alger, p. 6.

1850. *Anisops scutallaris*, Herrich-Shaffer, Die Wanzenartigen Insecten, vol. IX, p. 41, fig. 906.

1896. *Anisops scutellaris*, Matsumara, Trans. Sapporo Nat. Hist. Soc., vol. I, p. 28 (ecological note).

1915. *Anisops scutellaris*, Matsumura, Ent. Mag., Kyoto, vol. I, p. 110 (ecological note).

1915. *Anisops scutellaris*, Esaki, Ent. Mag. Kyoto, vol. I, pp. 31, 81 (ecological note).

1870. *Notonecta nanula*, Walker, The Zoologist (II), vol. V, p. 2381.

Size.—Males, length 6.0 mm.-6.2 mm., greatest body width 1.8 mm.-2.9 mm.; females, length 6.0 mm.-6.6 mm., greatest body width 1.9 mm.-2.1 mm.

Shape.—Subfusiform species; greatest body width about midway the body length.

Color.—General facies dark gray or black. Eyes dark brown. Vertex and pronotum testaceous, the latter may have irregular brown spots. Scutellum dark brown or black, lateral margins may be tinged with red or scutellum may be entirely red. Hemelytra hyaline and appear dark gray or black due to the color of the dorsal body surface; margins bordering scutellum and hemelytral commissure may be tinged with red. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the anterior margin almost straight; anterior margins of eyes extending slightly beyond that of the vertex; greatest width of head nine tenths the pronotal humeral width and six times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is almost one half the length of the pronotum with its humeral width slightly less than twice the median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised. Labrum long; median length equal to its basal width; apex rounded. Rostral prong (Pl. XLII, fig. 32b) shorter than third rostral segment; apex more or less accuminate. Anterior femur with apex more or less curved. Stridulatory comb (Pl. XLII, fig. 32c) of approximately twenty-one teeth. Chaetotaxy

of the male front leg as shown on Plate XLII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	119	75	..
Middle leg	100	82	36	25
Hind leg	100	82	29	31

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head almost nine tenths the pronotal humeral width and five times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior margin of the vertex; along the median longitudinal axis the head is almost one half the length of the pronotum. Pronotum with its humeral width slightly more than twice the median length; lateral margins diverging and slightly more than one half the median length of the pronotum; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	53	33
Middle leg	100	80	36	24
Hind leg	100	80	28	28

Location of types.—Fieber's type material in the Berlin Museum.

Comparative notes.—This species is very similar to *Anisops ares* Hutch. but does not have the long pronotum of this species. In *A. varia* the pronotum is twice the length of the head whereas in *A. ares* the pronotum is three times the length of the head.

Remarks.—This species has a rather wide recorded distribution occurring in Asia as well as in Africa. However, in the vast Pacific and Asiatic material available to me, not one specimen of this species was found. I am of the opinion that this species is composite, with the Asiatic form being another species entirely. There is need of a close examination of the type and the Asiatic forms placed with this species.

Data on distribution:

AFRICA

South Africa, Pine Mission, III-3-1926, one female, gift to H. B. H. fr. G. E. Hutchinson (F. H. Snow Coll.).

South Africa, Blaaukrantz Valley, pools in dried stream bed, IX-3-1926, gift to H. B. H. fr. G. E. Hutchinson, one female (F. H. Snow Coll.).

Egypt, Alexandria, E. de Bergevin, one male, one female (U. S. Nat. Mus.), two females, five males (F. H. Snow Coll.).

Abyssinia, Colonia Erytree, A. Thery, one male (F. H. Snow Coll.).

Mocambique, Vallee du Pungoue, Guengere, 1906, G. Vasse, four females (Paris Museum).

Afrique, Orient. Angl., Naivasha, 1904, Ch. Alluaud, one female (Paris Museum).

Basin Inf. du Zambeze, Vallee du Nuza, 1905, G. Vasse, one female (Paris Museum).

Sengal, Heudelot, one female (Paris Museum).

Cape-Town, E. Simon, 1898, Noualhier, two females (Paris Museum) one female (F. H. Snow Coll.).

Reg. de Zinder, Maradi (Mission, Tilmo) 1910, Dr. R. Gaillard, two females (Paris Museum).

Tchad, N'Guigmi, 1919, Dr. Noel, one male (Paris Museum).

Soudan, Nioro, 1909, F. de Zeltner, one male (F. H. Snow Coll.).

Sahel Soudanais, Goumbou 1909, F. de Zeltner, one male (Paris Museum).

Belgian Congo, Musoca, IX-1939, H. J. Bredo, one male, one female (Belguium Museum).

Erythraea, Ghenda, two females (Bueno Coll. of F. H. Snow Coll.).

SYRIA

Syrien, Kaifa, Reuter, one male, one female (Kirkaldy Coll. of the F. H. Snow Coll.).

Anisops robusta Hutchinson

(Pl. XLI, fig. 30)

1930. *Anisops robusta* Hutchinson, Proc. Zool. Soc. London, vol. XXIX, pp. 446-447, text figs. 3, a, b, c.

1933. *Anisops robusta*, Hutchinson, Internat. ges. Hydrob. Hydrog., vol. 28, pt. 5/6, p. 462 (ecological note).

Size.—Males, length 7.3 mm., greatest body width 2.2 mm.; females, length 7.3 mm., greatest body width 2.4 mm.

Shape.—Robust, subfusiform species; greatest body width midway the body length.

Color.—General facies gray. Eyes gray brown. Hemelytra hyaline and appears dark gray due to the dorsal dark body surface. Legs stramineous. Abdominal venter dark brown with keel and segmental margins stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head equal to the pronotal humeral width and five times the anterior width of the vertex; synthlipsis wide, almost one half the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the length of the pronotum. Pronotum with its humeral width one and two thirds the median length; lateral margins convexly curved and converging, one half the length of the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised. Labrum long, median length equal to the basal width; apex accuminate. Rostral prong (Pl. XLI, fig.

30b) slightly shorter than third rostral segment; apex accuminate. Fore leg (Pl. XLI, fig. 30a) with dorsal and ventral femoral margins almost parallel, apex rounded; stridulatory comb (Pl. XLI, fig. 30c) of approximately eleven teeth which increase in length from base to apex. Whether or not two apical teeth are missing from my specimen is not clear for Hutchinson (24) figures such a condition in his drawings. Chaetotaxy of the front leg as shown on Plate XLI. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	105	69	..
Middle leg	100	87	41	27
Hind leg	100	87	32	32

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal humeral width and four times the anterior width of the vertex; synthlipsis wide, almost one half the anterior width of the vertex; along the median longitudinal axis the head is over one half the length of the pronotum. Pronotum with its humeral width slightly more than twice the median length; lateral margins diverging and almost three fourths the median length, posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	105	48	26
Middle leg	100	84	41	23
Hind leg	100	80	35	35

Location of types.—Type material from Wouranboulchi, Abyssinia, in the British Museum.

Comparative notes.—The peculiar shape of the front femur and the convexly curved, converging lateral margins of the pronotum of the males of this species make it quite unique. *Anisops ares* Hutchinson is perhaps the most similar species, however, the fore femur of the males is not parallel sided for its entire length and the lateral margins of the pronotum are at most subparallel.

Data on distribution:

AFRICA

Abyssinia, Serpent Lake, Wouranboulchi, X-4-1926, J. Omer-Cooper one male, one female, exchange from the British Museum (F. H. Snow Coll.).

Abyssina, Wouranboulchi nr. Djem-Djem. X-5-1926, J. Omer-Cooper, one male (F. H. Snow Coll.).

Abyssinia, Wouranboulchi, marsh, X-5-1926, J. Omer-Cooper, one female (F. H. Snow Coll.).

Anisops sikoroensis n. sp.

(Pl. XLII, fig. 34; Pl. LVI, fig. 103)

Size.—Males, length, 10.5 mm., greatest body width 3 mm.; females, length 10 mm., greatest body width 3 mm.

Shape.—Large fusiform species, with greatest body width about one third the body length.

Color.—General facies red brown. Abdominal venter darker with keel and segmental margins of the connexivum red brown.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width of the head eight tenths the pronotal humeral width and five to six times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior width of the vertex; along the median longitudinal axis the head is one half as long as the pronotum. Pronotum with its humeral width twice the median length; lateral margins diverging and almost three fourths the median length; posterior margin convex, medianly emarginate. Facial tubercle with a slight median groove which extends to about midway the length of the frons, apical two thirds of groove bearing a median longitudinal row of long erect hairs. Labrum with basal width one and one fourth the median length; apex rounded. Rostral prong (Pl. LVI, fig. 103) shorter than third rostral segment; apex more or less accuminate. Stridulatory comb (Pl. XLII, fig. 34b) of approximately sixteen even-length teeth. Chaetotaxy of male front leg as shown on Plate XLII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	125	87	..
Middle leg	100	84	37	20
Hind leg	100	87	36	30

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head eight tenths the pronotal humeral width and six times the anterior width of the vertex; synthlipsis wide, two thirds the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the length of the pronotum. Pronotum with its humeral width slightly more than twice the median length; lateral margins diverging, two thirds the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	125	50	33
Middle leg	100	81	31	22
Hind leg	100	81	32	26

Location of types.—Male holotype, female allotype, Madagascar, Annanarivo, Sikoro, 1898, Noualhier, in the Paris Museum. One male paratype (same collection data as above) in the F. H. Snow Collection.

Comparative notes. — Very similar in general appearance to *A. grandis* Poisson, however, the latter lacks the groove on the frons and the median frontal row of erect hairs as found on the males of this species.

Data on distribution.—Known only from type series.

Anisops fijiensis n. sp.

(Pl. XL, fig. 24)

Size.—Males, length 4.6 mm.-4.9 mm., greatest body width 1.2 mm.-1.4 mm.; females, length 4.9 mm.-5.4 mm., greatest body width 1.3 mm.-1.5 mm.

Shape.—Small fusiform species, greatest body width about midway the body length.

Color.—General facies dark gray. Eyes brown. Vertex and pronotum testaceous or stramineous, the latter may be hyaline on its posterior margin and appear the color of the underlying scutellum. Scutellum black, orange, or black with orange or testaceous apex. Hemelytra hyaline and appear dark gray as it overlies the black dorsal body surface. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest head width nine tenths the pronotal humeral width, six to seven times the anterior width of the vertex; synthlipsis wide, approximately one half the anterior width of the vertex; along the median longitudinal axis the head is three fourths the pronotal length. Pronotum with its humeral width twice its median length; lateral margins diverging and almost one half the median length; posterior margin convex, medianly emarginate. Facial tubercle laterally compressed forming a slight carina which runs anteriorly to apex of frons. Labrum short; basal width one and three fourths its median length; apex rounded. Rostral prong (Pl. XL, fig. 24b) as long as third rostral segment; apex accuminate. Stridulatory comb (Pl. XL, fig. 24c) of approximately twenty teeth which gradually decrease in length from base to apex; apical tooth almost one half the length of the basal tooth. Chaetotaxy of the male front leg as shown on Plate XL. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	84	..
Middle leg	100	80	37	26
Hind leg	100	82	30	31

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest head width nine tenths the pronotal humeral width, six times the anterior width of the vertex, synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the pronotal length. Pronotum with humeral width slightly more than twice the median length; lateral margins diverging and almost one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	128	55	36
Middle leg	100	80	36	27
Hind leg	100	82	31	31

Location of types.—Male holotype, female allotype, five male and six female paratypes, Fiji Islands, Taveuni, in shallow fresh water swamp above high tide, VIII-1934, R. W. Paine in the Snow Entomological Collection. Other paratypes are as follows. In the Snow Entomological Collection: four males, three females, Fiji Islands, Taveuni, from shallow muddy pool in coconut plantation, VIII-1934, R. W. Paine; three males, two females, Fiji Islands, IV-19-39, R. A. Lever.

Comparative notes.—Though somewhat smaller, this species by its carinate frons and coloration resembles *Anisops tahitiensis* Lundblad. *Anisops fijiensis*, however, lacks the enlarged truncate apex of the male front femur as found on *A. tahitiensis* Lundblad.

Data on distribution.—Known only from type series.

Anisops adonis Hutchinson

(Pl. XLI, fig. 29)

1928. *Anisops adonis* Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. I, pp. 157-159, text fig. 2.

1933. *Anisops adonis*, Hutchinson, Internat. Rev. ges. Hydrob. Hydrog., vol. 28, pt. 5/6, p. 462 (ecological note).

Size.—Males, length 5.2 mm.-5.5 mm., greatest body width 1.5 mm.-1.6 mm.; females, length 5.1 mm.-5.4 mm., greatest body width 1.5 mm.-1.8 mm.

Shape.—Small fusiform species; greatest body width about midway the body length.

Color.—Brown form: General facies stramineous. Eyes brown. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous. *Dark form:* General facies dark brown or black. Eyes dark brown. Vertex and pronotum stramineous. Scutellum dark brown or black. Hemelytra hyaline, appear black due to the underlying black dorsal body surface. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head eight tenths the pronotal humeral width and six times the anterior width of the vertex; synthlipsis wide, slightly more than one third the anterior width of the vertex; along the median longitudinal axis the head is three fourths the length of the pronotum. Pronotum with is humeral width two and one half times the median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. Facial tubercle laterally compressed with a faint median carina that extends anteriorly on the frons. Rostral prong (Pl. XLI, fig. 29b) shorter than the third rostral segment; apex more or less rounded. Labrum long with its median length equal to its basal width; apex rounded; provided with a few long scattered hairs. Stridulatory comb (Pl. XLI, fig. 29c) of approximately seven, even-length, short, cylindrical teeth. Chaetotaxy of the front leg as shown on Plate XLI. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	128	83	..
Middle leg	100	88	44	29
Hind leg	100	82	37	34

Female structural characteristics.—Viewed from above, the outline of the head is rounded with its greatest width eight tenths the pronotal humeral width and four and one half times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is two thirds the length of the pronotum. Pronotum with its humeral width almost two and one half times the median length; lateral margins diverging and three fourths the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	125	67	50
Middle leg	100	85	40	27
Hind leg	100	82	36	33

Location of types.—Male type and female allotype, N. Nigeria, Zungeru, in the British Museum.

Comparative notes.—This species appears closely allied to *A. jaczewski* Hutchinson, both have a laterally compressed frons and similar chaetotaxies on the male front legs. However, the males of the latter have a short front tarsus, only about one half the length of the fore tibiae and a narrower synthlipsis, about one third the anterior width of the vertex, whereas in the case of *A. adonis* the males have the front tarsi two thirds the length of the tibiae and the synthlipsis is two thirds the anterior width of the vertex.

Data on distribution:

AFRICA

Soudan, Rock pool, R. Yei Equatoria, Dec. 11, 1937, J. G. Myers, four males, four females (F. H. Snow Coll.); eleven males, twenty-seven females (British Nat. Hist. Museum).

Nigeria, Olokemiji, J. C. Birdwell, two males, six females (U. S. Nat. Mus.).

Nigeria, Olokemiji, Iboda, one male (U. S. Nat. Mus.).

Anisops jaczewski Hutchinson

(Pl. XL, fig. 25)

1928. *Anisops jaczewski* Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. I, p. 304.

1929. *Anisops jaczewski*, Hutchinson, Ann. South African Mus., vol. XXV, pt. 3, pp. 403-404, Pl. XXX, fig. 18; Pl. XXXII, figs. 5, 8.

1939. *Anisops jaczewski*, Poisson, Bull. Soc. Ent. France, vol. 44, p. 43 (ecological note).

Referring to this species also:

1926. *Anisops vitrea*, Horvath, Arch. för Zool., vol. 18A, no. 31, p. 2 (determined in error, actually *A. jaczewski* Hutchinson).

1926. *Anisops vitrea*. Jaczewski, Analibus Zoologicis Musei Polonici Historiae Naturalis, vol. V, p. 86, text figs. 42, 43, 44 (determined in error; actually *A. jaczewski* Hutchinson).

Size.—Males, length 4.5 mm.-4.7 mm., greatest body width 1.2 mm.; females, length 4.8 mm., greatest body width 1.4 mm.

Shape.—Small subfusiform species; lateral margins in anterior half of body almost parallel, lateral margins of posterior half strongly converging.

Color.—General facies gray. Eyes brown. Vertex, pronotum, and scutellum testaceous. Hemelytra hyaline and appears dark gray due to color of the dorsal body surface. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head eight tenths the pronotal humeral width and six times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is three fourth the pronotal length. Pronotum with its humeral width twice its median

length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. Facial tubercle laterally compressed forming a median carina which runs forward on the frons. Labrum short, basal width one and one third the median length; apex rounded. Rostral prong (Pl. XL, fig. 25b) shorter than the third rostral segment; apex more or less accuminate. Stridulatory comb (Pl. XL, fig. 25c) of approximately ten teeth which increase slightly in height from base to apex. Chaetotaxy of the male front leg as shown on Plate XL. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	110	60	..
Middle leg	100	86	36	28
Hind leg	100	76	32	30

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head eight tenths the pronotal humeral width and four and one half times the anterior width of the vertex; synthlipsis wide, slightly more than one third the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the length of the pronotum. Pronotum with its humeral width twice the median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	46	30
Middle leg	100	78	33	28
Hind leg	100	82	31	29

Location of types.—Type material from Transvaal, Africa in the British Museum.

Comparative notes.—This species is closely related to *A. adonis* Hutch. However the male front tarsus is shorter than in the case of the latter, being slightly more than one half the length of the fore tibia whereas the fore tarsus of *A. adonis* is fully two thirds the length of the fore tibia. Also the teeth of the stridulatory comb of *A. adonis* do not overlap one another as in the case of *A. jaczewski* but are distinct and separate from one another.

Data on distribution:

Africa

Transvaal, Main Drift, Limpopo R. Messina, V-29-1927, one male, gift to H. B. H. fr. G. E. Hutchinson (F. H. Snow Coll.).

Khami River below Niur, VI-27-1921, one female, gift to H. B. H. fr. G. E. Hutchinson (F. H. Snow Coll.).

Sudan Africa, Rock pool, R. Yei Equatoria, Dec. 11, 1937, J. G. Myers, four males, four females (F. H. Snow Coll.) eight males, fourteen females (Brit. Mus.).

Basin du Chari, Rievere Gribanjui, Mission Chari-Tchad, Jan. 1904, DeCorse, two males, one female (Paris Museum).

Cameron, 1920, Dr. Noel, one female, one male (Paris Museum).

Moyen Chari, Fort Archambault, Mission Chari-Tchad, I-1904, Dr. J. DeCorse, one male, one female (Paris Museum).

Rahr-al-Chazal, Souch-Nassili, 1912, Dr. R. Gaillard, one male, one female (Paris Museum).

Portuguese East Africa, C. W. Howard, two males (U. S. Nat. Mus.).

Anisops semita n. sp.

(Pl. XLII, fig. 33)

Size.—Males, length 4.2 mm.-4.5 mm., greatest body width 1.1 mm.-1.2 mm.; females, length 4.1 mm.-4.5 mm., greatest body width 1.1 mm.-1-2 mm.

Shape.—Small, fusiform species; greatest body width about midway its body length.

Color.—General facies stramineous. Eyes brown. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal width, slightly more than five times the anterior width of the vertex; synthlipsis wide, almost one half the anterior width of the vertex; along the median longitudinal axis the head is slightly more than two thirds the length of the pronotum. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and approximately one half the median length of the pronotum; posterior margin convex, medianly emarginate. Facial tubercle with a longitudinal depression forming two lateral ridges which bear long erect hairs. These two rows of hairs continue down the lateral margins of the labrum to the apex of the rostrum. Labrum broad; basal width twice its median length; apex rounded. Rostral prong (Pl. XLII, fig. 33b) as long as the third rostral segment; apex accuminate. Stridulatory comb (Pl. XLII, fig. 33c) of approximately nine teeth, the basal four twice the length of the apical five. Chaetotaxy of the male front leg as shown on Plate XLII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	76	..
Middle leg	100	95	37	25
Hind leg	100	78	30	30

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest head width nine tenths the pronotal humeral width, four to five times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the length of the pronotum. Pronotum with its humeral width twice its median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	121	52	28
Middle leg	100	78	45	26
Hind leg	100	77	32	31

Location of types.—Male holotype, Australia, N. Queensland, Barren River nr. Barren Waters, IX-28-38, R. G. Wind, in the Snow Entomological Collection. Female allotype, three male and ten female paratypes, Queensland, Coen C. York, May, '32, Harv. Austral. Exped., Darlington, in the Harvard Museum of Comparative Zoology. Other paratypes are as follows: One male, two females, Queensland, Coen C. York, May, '32, Harv. Austral. Exped., Darlington, in the Snow Entomological Collection.

Comparative notes.—This species is closely related to *Anisops canaliculata* n. sp. and can only be distinguished from it on the basis of the males which have the two rows of erect hairs which extend from the ridges of the facial tubercle to the fourth rostral segment.

Data on distribution.—Known only from type series.

Anisops canaliculata n. sp.

(Pl. XLIII, fig. 35)

Size.—Males, length 4.5 mm.-4.6 mm., greatest body width 1.3 mm.-1.4 mm.; females, length 4.9 mm.-5.4 mm., greatest body width 1.3 mm.-1.4 mm.

Shape.—Small species, only slightly fusiform; lateral margins in anterior half of body subparallel, only slightly converging, converging in posterior half of body.

Color.—General facies testaceous. Eyes brown. Pronotum and scutellum may be irregularly tinged with orange. Scutellum may have two triangular black patches, one on each side of the anterior half, projecting back from the posterior pronotal margin. Legs testaceous. Abdominal venter black with keel and segmental margins of the connexivum testaceous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with its greatest width nine tenths the pronotal humeral width and at least four times the anterior width of the vertex; synthlipsis wide, at least one third the anterior width of the vertex; along the median longitudinal axis the head is at least one half as long as the pronotum. Pronotum with its humeral width at least twice its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. Facial tubercle with a median longitudinal groove. Labrum short; basal width one and one half times its median length, apex rounded; faint median depression extending from base to apex. Rostral prong (Pl. XLIII, fig. 35b) slightly shorter than third rostral segment and with apex accuminate. Stridulatory comb of approximately ten teeth with basal five twice as long as apical five. Chaetotaxy of the male front leg as shown on Plate XLIII, fig. 35a. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	127	61	..
Middle leg	100	80	36	24
Hind leg	100	82	33	35

Female structural characteristics.—Viewed from above, the outline of the head is rounded with its greatest width nine tenths the pronotal humeral width and at least four times the anterior width of the vertex; synthlipsis wide, slightly less than one half the anterior width of the vertex; along the median longitudinal axis the head is three fifths the length of the pronotum. Pronotum with its humeral width twice its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	127	52	35
Middle leg	100	75	36	26
Hind leg	100	75	30	32

Location of types.—Male holotype, female allotype, three male and seven female paratypes, N. Queensland, Barren River nr. Barren Waters, 9-28-38, R. G. Wind in the Snow Entomological Collection. Other paratypes are as follows: In the Harvard Museum of Comparative Zoology: one male, six females, Queensland, Australia, Townesville, Mar. '32, Harv. Austr. Exped., Darlington.

Comparative notes.—Its small size, wide synthlipsis, and depressed facial tubercle are strongly suggestive of *A. nivea* (Fabri-

cius). However, the males of the two species serve to distinguish them quite readily. The males of *A. canaliculata* lack the three tufts of labral hairs and the peculiarly curved tarsal claws of the middle leg as found on *A. nivea*. For comparison of the chaetotaxies of the male front legs see Pl. XLIII, fig. 35a and Pl. XLIII, fig. 39a.

Data on distribution:

Australia

New Queensland, Townesville, 1920, G. F. Hill, five males, six females (Bueno Coll. of F. H. Snow Coll.).

Anisops psyche Hutchinson

(Pl. XLIII; fig. 38)

1928. *Anisops psyche* Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. 1, pp. 159-160, text fig. 3.

1929. *Anisops psyche,* Hutchinson, Ann. South African Mus., vol. XXV, pp. 400-402, Pl. XXX, fig. 20; Pl. XXXII, fig. 3.

1930. *Anisops psyche,* Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. VI, p. 58 (ecological note).

1930. *Anisops psyche,* Hutchinson, Proc. Zool. Soc. London, vol. XXIX, pt. 2, pp. 449-450 (ecological note).

1932. *Anisops psyche,* Hutchinson, Proc. Zool. Soc. London, vol. XXXI, pt. 1, p. 125 (ecological note).

1934. *Anisops psyche,* Poisson, Mus. Nat. Hist. Natur., vol. III, p. 211 (ecological note).

Size.—Males, length 5.7 mm., greatest body width 1.5 mm.; females, length 5.7 mm., greatest body width 1.5 mm.

Shape.—Small, fusiform species; greatest body width midway the body length.

Color.—General facies brown. Eyes brown. Vertex and pronotum testaceous, the latter may be hyaline and appear the color of the scutellum. Scutellum orange or testaceous. Hemelytra hyaline and appear the brown color of the underlying scutellum. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the anterior margin almost straight; greatest width of the head eight tenths the pronotal humeral width and almost five times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is almost one half the length of the pronotum. Pronotum with its humeral width twice the median length; lateral margins diverging and three fifths the median length; posterior margin convex, medianly emarginate. Facial tubercle excavate with lateral margins carinate. Labrum short, basal width twice the median length; apex rounded. Rostral prong (Pl. XLIII, fig.

38b) shorter than the third rostral segment; apex accuminate. Stridulatory comb (Pl. XLIII, fig. 38c) of approximately eight even-length teeth. Keel of second abdominal segment laterally expanded and triangularly excavate; lateral margins carinate and bearing long erect hairs; excavation lined with short, procumbent hairs. Connexivum of the third abdominal segment with a row of nodules on its ventral surface which becomes progressively smaller toward the apex, nodules continued onto the connexivum of the fourth abdominal segment. Chaetotaxy of the front leg as shown on Plate XLIII. The relative lengths of the parts of the legs are as follows: *

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	..	..
Middle leg	100	82	36	28
Hind leg	100	83	36	36

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal humeral width and five times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior width of the vertex; along the median longitudinal axis the head is at least one half the length of the pronotum. Pronotum with its humeral width almost three times the median length; lateral margins diverging and slightly more than one third the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	122	55	35
Middle leg	100	82	36	28
Hind leg	100	83	34	34

Location of types.—Type material from Kampala, Uganda in the British Museum.

Comparative notes.—Very closely allied to *Anisops hancocki* Hutchinson from which it differs by the males not having the fore femur greatly enlarged dorso-ventrally just before the base. For comparison of the chaetotaxies of the front legs of the males see Plate XLIII, fig. 38a and Plate XLVI, fig. 52a.

Data on distribution:

AFRICA

Kueni River, VI-27-1927, one male, gift to H. B. H. fr. G. E. Hutchinson (F. H. Snow Coll.).

Salisbury, Makahiri River, VII-3-1927, one female, gift to H. B. H. fr. G. E. Hutchinson (F. H. Snow Coll.).

* Tarsi of single male specimen lacking.

Anisops genji Hutchinson

(Pl. XLIII, fig. 36)

1927. *Anisops genji,* Hutchinson, Ann. Mag. Nat. Hist., Ser. 9, vol. XIX, pp. 377-378, text fig. 2.

1929. *Anisops genji,* Hutchinson, Ann. South African Mus., vol. XXV, p. 383, Pl. XXX, fig. 5.

1933. *Anisops genji,* Lundblad, Arch. für Hydrob., Suppl. vol. XII, p. 145 (a list of Indo-australian and Pacific forms of this genus).

1933. *Anisops genji,* Lundblad, Sartryck ur Entomogolisk Tidskrift Haft. 3-4, pp. 265-267, text figures 8, A, B. C, D, E, F, G, & Pl. 15 lower right fig.

1941. *Anisops genji,* Hoffmann, Lingnan Sci. Jour., vol. XX, p. 59 (catalogue).

Referring to this species also:

1896. *Anisops scutellaris,* (*nec* Herrich-Shaffer) Uhler, Proc. U. S. Nat. Mus., Vol. VII, p. 275 (believed by Hutchinson to be *Anisops genji*).

1928. *Anisops fieberi,* Jaczewski, Ann. Mus. Zool. Polonici. vol. VII, p. 113, Pl. XVI, figs. 18, 19, 20, 21 (his drawings are of *Anisops genji* Hutch. and not of *Anisops nasuta* Fieb. (*A. fieberi* Kirk.).

Size.—Males, length 5.8 mm.-6.6 mm., greatest body width 1.6 mm.-1.8 mm.; females, length 6.1 mm.-6.6 mm., greatest body width 1.6 mm.-1.8 mm.

Shape.—Fusiform species; greatest body width about one third its length.

Color.—Eyes gray or brown. Vertex and pronotum testaceous, the latter may be hyaline on its posterior margin and appear the color of the underlying scutellum. Scutellum testaceous, black, or black with its apex testaceous or orange. Hemelytra hyaline and appear the underlying color of the dorsal body surface which may be black, or testaceous with the apical abdominal segments alternating brown and black. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous or brown.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the vertex extending slightly beyond the anterior margins of the eyes; greatest width of the head nine tenths the pronotal humeral width and four to five times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half as long as the pronotum. Pronotum with its humeral width almost twice its median length; lateral margins diverging and almost one half the median length; posterior margin convex, medianly emarginate. Frons triangularly excavate, bordered on each side by two carinae, the outer of which meet apically to form an accuminate apex. Anterior interocular space with a median carina which meets the accuminated apex of the frons. Labrum short; basal width one and two thirds its median length; apex accuminate;

each basal angle of the labrum bears a long tuft of hairs which curve anteriorly along the outer carinae of the frons. Rostral prong (Pl. XLIII, fig. 36b) slightly shorter than the third rostral segment; apex accuminate. Stridulatory comb (Pl. XLIII, fig. 36c) of approximately thirteen even-length teeth. Chaetotaxy of the male front leg as shown on Plate XLIII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	103	64	..
Middle leg	100	81	42	22
Hind leg	100	85	36	36

Female structural characteristics.—Viewed from above, the outline of the head is rounded with the anterior margin of the vertex extending slightly beyond that of the eyes; greatest width of the head nine tenths the pronotal humeral width and five to six times the anterior width of the vertex; synthlipsis wide, slightly more than one third the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the length of the pronotum. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and over one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	114	57	33
Middle leg	100	83	42	25
Hind leg	100	81	35	35

Location of types.—Male type, two male and one female paratypes, "Japan" in the collection of G. E. Hancock.

Comparative notes.—The excavate facial tubercle, labral hairs, and the curved middle tarsal claws of the males strongly relate this species to *A. nivea* (Fabricius). However, the excavation of *A. genji* extends the length of the frons whereas on *A. nivea* it is restricted to the facial tubercle. Also the excavation of the latter species is bordered on each side by only one carina whereas in *A. genji* it is bordered on each side by two carinae. In addition, the median tuft of labral hairs as found on *A. nivea* is lacking in this species.

Data on distribution:

JAPAN

Shimbara Peninsula, Unzen, 2200′, Sept. 4, 1937, E. Suenson, eighteen males, fifty-six females (F. H. Snow Coll.).

Kobe, Baker, two males, nine females (U. S. Nat. Mus.).

CHINA

Soochow, fr. N. Gist. Gee, five males, ten females (F. H. Snow Coll.).

Shanghai, E. Suenson, one female (F. H. Snow Coll.).

Peking, X-13-25, P. W. Claassen, Tsing Huo Col., twenty-one males, twenty-two females (F. H. Snow Coll.).

Peking, X-13-24, P. W. Claassen, Tsing Huo Col., eight males, six females (F. H. Snow Coll.).

Peking, X-15-24, P. W. Claassen, Tsing Huo Col., three males, three females (F. H. Snow Coll.).

Peking, XI-10-24, P. W. Claassen, Tsing Huo Col., three males, ten females (F. H. Snow Coll.).

Manchuria, Yablonya St., VII-20-1940, via Weyman, one male, one female (F. H. Snow Coll.).

Manchuria, Dairen, X-8-40, Michael Weyman, two males (F. H. Snow Coll.).

Shanghai, Aug. 20, 1939, via Weyman, one male, one female (F. H. Snow Coll.).

Manchuria, X-15-38, M. J. Nikitin, one male (F. H. Snow Coll.).

Soochow, Chenfu F. Wu, one male (F. H. Snow Coll.).

Peking, Chenfu F. Wu, two females (F. H. Snow Coll.).

Foochow, Chenfu F. Wu, one female (F. H. Snow Coll.).

Hangchow, Chenfu F. Wu, one female (F. H. Snow Coll.).

Szechwan, Chenfu F. Wu, one male (F. H. Snow Coll.).

Suifu Szechwan, D. C. Graham, twelve males, thirteen females (F. H. Snow Coll.).

Anisops nivea (Fabricius)

(Pl. XLIII, fig. 39; Pl. LIV, fig. 93)

1775. *Notonecta nivea* Fabricius, Systema Entomologiae. Flenaburgi et hipsiae, p. 690.

1794. *Notonecta nivea,* Fabricius, Entomologia Systema, vol. IV, p. 58.

1803. *Notonecta nivea,* Fabricius, Systema Rhyngatorum, p. 103 (list of species of *Notonecta*).

1840. *Anisops nivea,* Spinola, Essais sur les Insectes Hemipteres Rhyngotes ou Heteropteres, p. 58 (determined in error, actually *A. sardea* Herrich-Shaffer).

1840. *Anisops nivea,* Rambur, Faune entomologique de l'Andalouise, vol. II, p. 191 (determined in error, actually *A. sardea* Herrich-Shaffer).

1847. *Anisops nivea,* Costa, Atti del Reale Instituta L'Incoraggiamento Alle Scienze Naturali di Napoli, vol. VII, p. 148 (determined in error, actually *A. sardea* Herrich-Shaffer).

1848. *Anisops niveus,* Amyot, Entomologie Franciase, Rhynchotas, p. 338 (determined in error, actually *A. sardea* Herrich-Shaffer).

1851. *Anisops niveus,* Fieber, Abhandl. Konigl. bohm. Ges. Wiss., vol. 7, p. 484 (determined as *A. niveus* though in parenthesis he named it *A. nasuta*).

1899. *Anisops niveus,* Kirkaldy, Ann. Soc. Ent. France, vol. LXVIII, p. 105 (determined in error, probably *A. pellucens* Gerst).

1901. *Anisops niveus,* Kirkaldy, The Entomologist, vol. XXXIV, p. 5 (determined in error).

1904. *Anisops niveus,* Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 118-119, 132 (determined in error, probably *A. pellucens* Gerst.).

1905. *Anisops nivea,* Matsumura, Trans. Sapporo Nat. Hist. Soc., vol. I, p. 28 (determined in error, actually *A. nasuta* Fieber).

1906. *Anisops niveus,* Distant, Fauna of British India, Rhynchota, vol. III, p. 46 (determined in error).

1908. *Anisops nivea,* Kirkaldy, Y. sjostedt: Wissenschaften Ergebn. der schwed. zool. Exped. Hemiptera. XII, p. 24 (determined in error, probably *A. pellucens* Gerst).

1915. *Anisops niveus,* Esaki, Ent. Mag., Kyoto, vol. I, p. 31 (determined in error, actually *A. nasuta* Fieber).

1915. *Anisops niveus,* Matsumura, Ent. Mag., Kyoto, vol. I, p. 110.

1918. *Anisops niveus,* Paiva, Rec. Ind. Mus., vol. XIV, p. 27 (ecological note).

1919. *Anisops niveus,* Paiva, Rec. Ind. Mus., vol. XV, p. 13 (ecological note).

1926. *Anisops niveus,* Esaki, Ann. Mus. Nat. Hungarici, vol. XXIV, p. 187 (determined in error).

1927. *Anisops niveus,* Dover, Jour. Bombay Nat. Hist. Soc., vol. XXXII, p. 615.

1927. *Anisops niveus,* Torre Bueno, Bull. Brooklyn Ent. Soc., vol. XXII, p. 30 (determination questionable).

1928. *Anisops nivea,* Esaki, Insects of Samoa II, p. 76 (mentioned in footnote the correct location of type).

1929. *Anisops niveus,* Hutchinson, Ann. South African Mus., vol. XXV, p. 385 (mentions the need of a closer study of the type, as the species seems to be composite).

1929. *Anisops niveus,* Poisson, Faune des Colonies Francaises, vol. III, p. 154 (determined in error, actually *A. pellucens* Gerst).

1933. *Anisops niveus,* Hoffmann, Lingnan Sci. Jour., vol. XII, pp. 255-256 (catalogue; of little value for at least two species are mixed).

1933. *Anisops niveus,* Wu, Lingnan Sci. Jour., vol. XII, pp. 213-214 (catalogue; of little value for at least two species are mixed).

1933. *Anisops niveus,* Lundblad, Arch. für Hydrob., Suppl. vol. XII, pp. 145, 163-166, text fig. 56.

1935. *Anisops niveus,* Wu, Catalogus Insecturum Sinensium, vol. II, p. 576.

1941. *Anisops niveus,* Hoffmann, Lingnan Sci. Jour., vol. XX, pp. 60-61 (catalogue; this species omitted as it is composite; therefore distribution questionable).

Size.—Males, length 4.8 mm.-5.1 mm., greatest body width 1.2 mm.-1.4 mm.; females, length 4.8 mm.-5.4 mm., greatest body width 1.3 mm.-1.8 mm.

Shape.—Fusiform species, greatest body width about one half the length of the body.

Color.—General facies pearlaceous. Eyes brown. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width of the head nine tenths the pronotal humeral width and four to five times the anterior width of the vertex; synthlipsis wide, approximately one third the anterior width of the vertex; along the median longitudinal axis the head is seven eighths the length of the pronotum. Pronotum with its humeral width slightly more than twice the median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. Facial tubercle with a triangular excavation bordered on each side by a raised carina. Labrum broad and short; basal width almost twice its median length; apex more or less accuminate; base with a transverse row of long hairs with the outer one on each side grouped together to form a tuft which curves anteriorly on the excavate facial tubercle, the inner group erect. Rostral prong (Pl. LIX, fig.

93) longer than the third rostral segment; apex accuminate. Stridulatory comb (Pl. XLIII, fig. 39b) of approximately fifteen even length teeth. Middle tarsal claws strongly curved inward at base; posterior claw thicker than anterior one. Chaetotaxy of the front leg as shown on Plate XLIII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	102	79	..
Middle leg	100	85	40	25
Hind leg	100	78	33	33

Female structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width of the head eight to nine tenths the pronotal humeral width and four to five times the anterior width of the vertex; synthlipsis wide, almost one half the anterior width of the vertex; along the median longitudinal axis the head is three fifths the length of the pronotum. Pronotum with its humeral width slightly more than its median length; lateral margins diverging and six tenths the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	116	60	33
Middle leg	100	79	38	22
Hind leg	100	83	33	33

Location of types.—Fabricius' type material from India located in the Keil Museum.

Comparative notes.—This species is closely related to *A. genji* Hutch., but may be readily separated from it on the basis of the males. The males of *A. nivea* have the excavation restricted to the facial tubercle whereas in *A. genji* the excavation extends almost the full length of the frons. The excavation is bordered by one carina on each side in the former species whereas in the latter the excavation is bordered by two carinae on each side.

Bibliographical notes.—Kirkaldy in 1904 (30) as a result of a study of the type of *Anisops ciliata* Stål and what he erroneously believed to be the type of *A. niveus* (Fabricius) declared the two to be the same and placed several other species into synonomy therewith. It has since been shown by Lundblad (32) that what Kirkaldy thought was the type of *A. nivea* was not the type at all. Many of the references that Kirkaldy placed with *A. nivea* I have been able to place with their correct species, others defy determination due to poor or no accompanying description.

Notonecta ciliata Fabricius which both Stål and Kirkaldy felt was an Anisops, is actually an Enithares. However, *Anisops ciliata* Stål from the Ile de France is a valid Anisops species. *Anisops hyalinus* Fieber was first placed as a possible synonym of *A. ciliata* by Stål and later by Kirkaldy as a possible variety of *A. ciliata* only ever, it is much too large for *A. nivea,* and resembles *A. ciliata* only in size. I have found no species in my vast Asiatic material which fits the description of *A. hyalinus*, so I shall present a translation of the original description. Though highly inadequate, it is the only description of the species.

Data on distribution:

SUMATRA

Sumatra, Thienemanni, one male (gift from Lundblad) (F. H. Snow Coll.)

INDIA

Ganjam Dist., Barkuda, Chilka Lake, Madras Pres., VIII-18, F. H. Gravely, fifteen males, fifteen females (F. H. Snow Coll.); seventeen males, nine females (Indian Museum).

Ganjam Dist., Barkuda, Chilka Lake, Madras Pres., XI-23-19, N. A., eight males, twenty females (Indian Museum).

Ganjam Dist., Barkuda, Chilka Lake, Madras, N. A., one female (Indian Museum).

Ganjam Dist., Rambha, Madras, IX-20-13, Annandale, one male, seventeen females (Indian Museum), four males, three females (F. H. Snow Coll.).

Madras, Barkuda Id., Chilka Lake, VIII-4-7, one male, one female (Bueno Coll. of F. H. Snow Coll.).

Br. India, Coimbatore, L. V. Newton S. J. one male, one female (Bueno Coll. of F. H. Snow Coll.).

Anisops tahitiensis Lundblad

(Pl. XLIII, fig. 40)

1934. *Anisops tahitiensis* Lundblad, Bull. Bernice Pauki Bishop Mus. Poly. Ethn. Nat. Hist., vol. 113, pp. 121-123, text figs. 1-5.

Size.—Males, length 5.1 mm.-5.5 mm., greatest body width 1.3 mm.-1.5 mm.; females, length 5.1 mm.-5.5 mm., greatest body width 1.3 mm.-1.5 mm.

Shape.—Slightly fusiform species; greatest body width almost midway the body length.

Color.—Gray form: General facies peralaceous. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous. *Brown form*: Eyes brown. Vertex and pronotum testaceous, the latter may be hyaline on its posterior margin and appear dark brown or black due to the underlying color of the scutellum. Scutellum testaceous or dark brown

with its lateral margins orange. Hemelytra hyaline and appear stramineous or dark brown depending on the color of the dorsal body surface. Legs stramineous. Abdominal venter dark brown or black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the anterior margin almost straight; greatest width of the head nine tenths of the pronotal humeral width and seven times the anterior width of the vertex; synthlipsis wide, slightly more than one third the anterior width of the vertex; along the median longitudinal axis the head is slightly more than three fourths the length of the pronotum. Pronotum with its humeral width approximately twice its median length; lateral margins diverging and from one half to three fifths the median length; posterior margin convex, medianly emarginate. Facial tubercle laterally compressed to form a median carina which proceeds anteriorly for the basal two thirds of the frons. Labrum with basal width one and one half times its median length; apex rounded. Rostral prong (Pl. XLIII, fig. 40b) longer than the third rostral segment; apex accuminate. Labrum with its basal width one and one half its median length. Stridulatory comb (Pl. XLIII, fig. 40c) of approximately twenty-one teeth. Chaetotaxy of the male front leg as shown on Plate XLIII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	111	77	..
Middle leg	100	84	77	27
Hind leg	100	81	30	31

Female structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width of the head nine tenths the pronotal humeral width and five and one half times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is three fifths as long as the pronotum; lateral margins diverging and one half as long as the pronotum; posterior margin convex, medianly emarginate. The relative lengths of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	115	50	34
Middle leg	100	77	36	25
Hind leg	100	87	31	32

Location of types.—Lundblad's type material, Tahiti, July 20, 1925, L. E. Cheesman, is in the British Museum.

Comparative notes.—This species is about the same size and general appearance as *Anisops cleopatra* Distant from which it can be separated on the basis of the males. The males of *A. cleopatra* lack the carinate frons and the rounded apex of the anterior femur. Also the head of the males of *A. tahitiensis* is much larger, the eyes being more voluminous, and almost straight on its anterior margin whereas the head of *A. cleopatra* has a curved anterior margin and the eyes are not voluminous.

Data on distribution:

GUADALCANAL

Jan., 1945, P. H. Eschmeier, four males, eight females (F. H. Snow Coll.).

1944, L. J. Lipovsky, twenty-three males, twenty-seven females (F. H. Snow Coll.).

NEW GUINEA

Rigo, 1889, L. Loria, two males, one female (F. H. Snow Coll.).

ANDAMAN ISLANDS

nr. W. Goast Isl., III-1914, C. J. Rogers, five males, eight females (Indian Museum).

NEW HEBRIDES

March 15, 1943, Oman, two males, four females (U. S. Nat. Mus.).

PHILIPPINE ISLANDS

Mindanao, Davao, Baker, two males, one female (U. S. Nat. Mus.).

OKINAWA

Sept. 18, 1945, W. D. Fields, six males, eight females (U. S. Nat. Mus.).

Anisops tasmaniaensis n. sp.

(Pl. XLVII, fig. 58)

Size.—Males, length 7.5 mm.-7.9 mm., greatest body width 2.4 mm.-2.5 mm.; females, length 7.8 mm.-7.9 mm., greatest body width 2.1 mm.-2.3 mm.

Shape.—Moderately large species; fusiform, with greatest body width midway the body length.

Color.—General facies stramineous. Eyes brown. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum brown.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head equal to pronotal humeral width, slightly more than seven times the anterior width of the vertex; synthlipsis wide, three fourths the anterior width of the vertex; along the median longitudinal axis the head is almost three fourths the pronotal length. Pronotum with its humeral width twice its median length; lateral margins diverging and slightly more

than one half the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised. Labrum long, medianly length equal to its basal width; apex rounded. Rostral prong (Pl. XLVII, fig. 58b) slightly shorter than third rostral segment; apex accuminate. Stridulatory comb (Pl. XLVII, fig. 58c) of approximately twenty-two teeth; basal five slightly shorter than the others. Chaetotaxy of front leg as shown on Plate XLVII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	127	83	..
Middle leg	100	83	41	24
Hind leg	100	80	32	32

Female structural characteristics.—Viewed from above, the outline of the head is rounded, with the vertex extending slightly beyond the anterior margins of the eyes; greatest width of the head nine tenths the pronotal humeral width, five times the anterior width of the vertex; synthlipsis wide, two thirds the anterior width of the vertex; along the median longitudinal axis the head is almost three fourths the pronotal length. Pronotum with its humeral width twice the median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	126	58	32
Middle leg	100	76	42	21
Hind leg	100	81	34	32

Location of types.—Male holotype, female allotype, two male and one female paratypes, Tasmania, Lake Leake, XI-1937, J. W. Evans, in the Snow Entomological Collection.

Comparative notes.—Though not quite as broad as *Anisops barbata* n. sp., it appears very similar to it. However, the males of this species lack the tufts of hairs as found on the male facial tubercle of *A. barbata.* For comparison of the male front legs of the two, see Plate XLVII, fig. 58a and Plate XLVI, fig. 54a.

Data on distribution.—Known only from type series.

Anisops lipovskyi n. sp.

(Pl. XLIII, fig. 37)

Size.—Males, length 5.4 mm.-6.0 mm., greatest body width 1.5 mm.-1.7 mm.; females, length 6. mm., greatest body width 1.6 mm.

Shape.—Small, fusiform species with its greatest width midway its body length.

Color.—General facies pearlaceous. Eyes brown. Hemelytra partly hyaline and such areas appear darker as they overlie the dark brown dorsal body surface. Legs stramineous. Abdominal ventor dark brown with keel and lateral margins stramineous.

Male structural characteristics.—As viewed from above, the outline of the head is rounded, with the anterior margin of the vertex extending slightly beyond that of the eyes; greatest width of head nine tenths the pronotal humeral width and seven times the anterior width of the vertex; synthlipsis wide, approximately one third the anterior width of the vertex; along the median longitudinal axis the head is at least one half the pronotal length. Pronotum with its humeral width about twice its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. Facial tubercle laterally compressed forming a median carina which extends anteriorly on the frons to the apex. Rostral prong (Pl. XLIII, fig. 37b) longer than third rostral segment; apex accuminate. Labrum short; basal width one and one third its median length, apex broad and rounded. Anterior femur (Pl. XLIII, fig. 37a) truncate at apex. Stridulatory comb (Pl. XLIII, fig. 37c) of about twenty-eight teeth; greatest width at basal third. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	110	71	..
Middle leg	100	81	38	28
Hind leg	100	82	39	39

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width nine tenths the pronotal humeral width and at least five times the anterior width of the vertex; synthlipsis wide, slightly less than one half the anterior width of the vertex; along the median longitudinal axis the head is approximately three fifths the pronotal length. Pronotum with humeral width at least twice its median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	114	51	33
Middle leg	100	78	39	26
Hind leg	100	83	31	31

Location of types.—Male holotype, female allotype Jor Pokri, Sitong, Darjiling Dist. E. Himalayas, India, X-22-17, N. A. and F. G. Paratypes are as follows. In the Indian Museum: One male,

Jor Pokri, 4800′, Darjiling, Dist. E. Himalayas, India, VII-6-18, S. Kemp; one male, one female, Jor Porki 4800′ nr. Sitong, Darjiling Dist. E. Himalayas, India, VII-6-18, S. Kemp. In the Snow Entomological Collection; one male, Calcutta, India, in pool, XI-15-11; two males, Jor Pokri, 4800′ Darjiling Dist. E. Himalayas, India, VI-6-18.

Comparative notes.—This species appears closely related to *Anisops tahitiensis* Lundblad, the males of both species have a carinate frons, an apically truncate femur and similar chaetotaxies on the front legs. The head serves best to distinguish the two, that of *Anisops tahitiensis* being broad and almost straight along its anterior margin whereas in *Anisops lipovskyi* the head is more or less conical shape with the vertex extending slightly beyond the eyes at the anterior margin.

Anisops deanei n. sp.

(Pl. XLIV, fig. 45)

Size.—Males, length 5.4 mm.-6.0 mm., greatest body width 1.3 mm.-1.5 mm.; females, length 5.7 mm.-6.3 mm., greatest body width, 1.5 mm.-1.7 mm.

Shape.—Fusiform, greatest body width midway the body length.

Color.—General facies stramineous. Eyes brown or gray. Scutellum may be irregularly tinged with crimson. Hemelytra hyaline and appear stramineous, red, or dark brown, depending on the dorsal body surface color. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous. Some forms are completely gray with the abdominal venter as above.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head nine tenths the pronotal humeral width, approximately seven times the anterior width of the vertex; synthlipsis variable, from slightly less than one third to almost one half the anterior width of the vertex; along median longitudinal axis head three fourths the pronotal length. Pronotal humeral width at least twice its median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. Facial tubercle only slightly raised; bearing scattered hairs. Labrum with basal width only slightly more than median length, apex rounded. Rostral prong (Pl. XLIV, fig. 45b) slightly longer than third rostral segment. Anterior femur slightly curved at apex. Stridulatory comb (Pl. XLIV, fig. 45c) of twenty-one to twenty-four even-length

teeth, apical one shorter than remainder. Chaetotaxy of front leg as shown on Plate XLIV. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	119	74	..
Middle leg	100	81	38	26
Hind leg	100	82	34	33

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width nine tenths the pronotal humeral width, six times the anterior width of vertex; width of synthlipsis variable from approximately one third to almost one half the anterior width of the vertex; along the median longitudinal axis the head is slightly more than three fourths the pronotal length. Pronotum with humeral width at least twice its median length; lateral margins diverging and more than one half the median length; posterior margin convex, medianly concave. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	123	62	35
Middle leg	100	78	39	27
Hind leg	100	87	36	39

Location of Types.—Male holotype, female allotype, sixteen males and ten female paratypes, New South Wales, Began River, F. Armstrong, via Mr. Deane in the Snow Entomological Collection. Other paratypes are as follows. In the Snow Entomological Collection: two males, three females, Queensland, St. George, Dist. 5, 1923, G. H. Williams; sixteen males, eleven females, Victoria Alexandria, F. L. Billinghurst (Kirkaldy Collection) in the Snow Entomological Collection.

Comparative notes.—This species is very similar to *Anisops hyperion* Kirkaldy.* The males of the two species offer a means of ready separation. The apex of the male front femur of *A. deanei* is slightly curved, whereas that of *A. hyperion* is accuminate. Also the apex of the third rostral segment of the male of *A. deanei* is decidely wider than the base of the fourth, whereas in *A. hyperion* the two areas are of about the same width. For comparison of the chaetotaxies of the front legs of the males see Plate XLIV, fig. 45a and Plate XXXVIII, fig. 16a.

Data on distribution:

AUSTRALIA

Victoria, Bacchus Marsh, 1904, six males, two females (Bueno Coll. of F. H. Snow Coll.).

* nec. *Anisops hyperion* Hale.

Anisops philippinensis n. sp.

(Pl. XLIV, fig. 44)

Size.—Males, length 5.4 mm.-5.8 mm., greatest body width 1.2 mm.-1.3 mm.; females, length 5.8 mm.-6.0 mm., greatest body width 1.5 mm.-1.6 mm.

Shape.—Small, broad-headed species; body fusiform with greatest width about midway the body length.

Color.—General facies dark gray. Vertex, pronotum, and scutellum testaceous, the latter may be black with only the anterior margin testaceous. Hemelytra hyaline and appearing dark gray as it overlies the black dorsal body surface. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the anterior margin almost straight; greatest width of head nine tenths to almost equal the pronotal humeral width, ten times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is nine tenths, to equal the pronotal length. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and at least one half the median length; posterior margin convex, medianly emarginate. Facial tubercle only slightly raised. Labrum with its basal width only slightly more than its median length; apex more or less accuminate. Rostral prong (Pl. XLIV, fig. 44b) slightly shorter than third rostral segment; apex accuminate. Stridulatory comb (Pl. XLIV, fig. 44c) of approximately seventeen teeth whose lengths increase from base to apex. Chaetotaxy of the male front leg as shown on Plate XLIV. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	83	..
Middle leg	100	85	40	28
Hind leg	100	87	30	33

Female structural characteristics.—Viewed from above, the outline of the head is rounded with its greatest width nine tenths the pronotal humeral width and seven times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is almost three fifths as long as the pronotum. Pronotum with its humeral width slightly more than twice its median length; lateral margins almost three

fifths the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	123	51	35
Middle leg	100	78	37	28
Hind leg	100	84	31	33

Location of types.—Male holotype, female allotype, forty-eight male and twenty female paratypes, Philippine Isl., Mindanao, Lake Linau, N. slope, Mt. Apo, Davao Prov. 7800′, 46, H. Hoagstraal and F. G. Werner, Zoological Expedition, in the Chicago Natural History Museum. Other paratypes are: ten males, ten females, same collection data as above, in the Snow Entomological Collection.

Comparative notes.—Of about the same size and general appearance as *Anisops tahitiensis* Lundblad from which it can be readily separated by the fact that the males do not posses the carinate frons and the apically rounded front femur as found on the males of *A. tahitiensis.*

Data on distribution.—Known only from type series.

Anisops cleopatra Distant

(Pl. XLIV, fig. 43)

1914. *Anisops cleopatra* Distant, Nova Caledonia, Zoologie, vol. I, p. 386, Pl. XI, fig. 8.

1923. *Anisops cleopatra,* Hale, Rec. South Austr. Mus., vol. II, no. 3, p. 413 (only a mention in a footnote).

1928. *Anisops cleopatra,* Esaki, Insects of Samoa, Part II, pp. 77-78, text fig. 5 (ecological note).

1933. *Anisops cleopatra,* Lundblad, Arch. für Hydrob., Suppl. vol. XII, pp. 145, 171-173, text figs. 59-62.

Size.—Males, length 5.4 mm.-5.8 mm., greatest body width 1.4 mm.-1.7 mm.; females, length 5.8 mm.-6.3 mm., greatest body width 1.5 mm.-1.8 mm.

Shape.—Fusiform species, with greatest body width about midway the body length.

Color.—General facies dark gray or black. Eyes dark brown or gray. Vertex and pronotum testaceous, the latter hyaline on posterior half and appearing the black color of the underlying anterior margin of the scutellum. Scutellum black with apex and lateral margins testaceous or red orange. Hemelytra hyaline and appearing dark gray or black due to the underlying color of the dorsal body surface. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths

the pronotal humeral width and seven times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is two thirds as long as the pronotum. Pronotum with humeral width slightly more than twice its median length; lateral margins diverging and three fifths the median length; posterior margin convex, medianly emarginate. Facial tubercle only slightly raised. Labrum with its basal width slightly more than its median length; apex truncate and almost one third the basal width. Rostral prong (Pl. XLIV, fig. 43b) longer than the third rostral segment; apex truncate, though very narrow in width. Stridulatory comb Pl. XLIV, fig. 43c) of approximately twenty-four teeth. Chaetotaxy of the male front leg as shown on Plate XLIV. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	104	69	..
Middle leg	100	85	40	30
Hind leg	100	87	31	32

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head nine tenths the pronotal humeral width and six times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior width of the vertex; along the median longitudinal axis the head is almost one half the length of the pronotum. Pronotum with its humeral width two and one half times its median length; lateral margins diverging and three fifths its median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	123	58	32
Middle leg	100	85	38	28
Hind leg	100	88	32	38

Location of types.—The type material from New Caledonia should be in the British Museum. However, neither Esaki (8) nor Lundblad (32) were able to find it. The latter is of the opinion that it may have been destroyed.

Comparative notes.—This species is about the same size and general appearance as *A. tahitiensis* Lundblad from which it can be readily separated by the fact that the males lack the laterally compressed facial tubercle and the carinate frons as found on *A. tahitiensis.*

Data on distribution:

NEW CALEDONIA

Nr. Noumea, July, 1940, F. X. Williams, eight males, ten females (F. H. Snow Coll.).

Noumea, A. Fauvel, one female, Kirkaldy Collection (F. H. Snow Coll.).

New Caledonia, Marie Schastien, Kirkaldy Collection (F. H. Snow Coll.).

Anisops praetexta Hutchinson

(Pl. XLIV, fig. 41)

1929. *Anisops praetexta* Hutchinson, Ann. South African Mus., vol. XXV, pt. 3, pp. 402-403, Pl. XXX, fig. 19; Pl. XXXII, fig. 4, 4a.

1934. *Anisops praetexta*, Poisson, Bull., Soc. Zool. France, vol. XXIX, p. 100 (ecological note).

Size.—Males, length 5.4 mm., greatest body width 1.4 mm.; females, length 5.1 mm.-5.4 mm., greatest body width 1.4 mm.-1.6 mm.

Shape.—Small fusiform species, greatest body width about midway the body length.

Color.—General facies brown. Vertex, pronotum, and scutellum testaceous. Hemelytra hyaline and appears dark brown due to the color of the dorsal body surface. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head almost nine tenths the pronotal humeral width and slightly more than seven times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is almost as long as the pronotum. Pronotum with its humeral width two and one third times its median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex medianly emarginate. Facial tubercle slightly raised. Labrum with its basal width equal to its median length; apex rounded. Rostral prong (Pl. XLIV, fig. 41b) longer than third rostral segment. Stridulatory comb (Pl. XLIV, fig. 41c) of approximately twelve teeth. Chaetotaxy of male front leg as shown on Plate XLIV. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	87	..
Middle leg	100	80	40	25
Hind leg	100	84	33	34

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the

pronotal humeral width and five to six times the anterior width of the vertex; synthlipsis wide, slightly more than one third the anterior width of the vertex; along the median longitudinal axis the head is two third the length of the pronotum. Pronotum with its humeral width two and one half times its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	117	52	37
Middle leg	100	83	40	25
Hind leg	100	85	30	33

Location of types.—Type material from Southern Rhodesia in the South African Museum.

Comparative notes.—Very similar to *Anisops amaryllis* Hutch. and superficially the two species are almost identical. However, *A. amaryllis* does not have the short row of small setae on the basal inner surface of the male fore tarsi, as found on *A. praetexta.*

Data on distribution:

Africa

Central Africa, one male, one female (Basel Nat. Hist., Switzerland) one female (F. H. Snow Coll.).

Anisops barbata n. sp.

(Pl. XLVI, fig. 54)

Size.—Males, length 8.6 mm.-9.3 mm., greatest body width 2.4 mm.-3 mm.; females, length 8 mm.-9.1 mm., greatest body width 2.8 mm.-3 mm.

Shape.—Robust, slightly fusiform species with the greatest body width about midway the body.

Color.—Gray form: General facies gray. Eyes brown. Hemelytra may be partly hyaline and such areas appear darker as they overlie the dark brown dorsal body surface. Legs testaceous. Abdominal venter black with keel and segmental margins of the connexivum testaceous. *Stramineous form:* General facies stramineous. Eyes brown. Legs stramineous; abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—As viewed from above, the outline of the head is rounded with the anterior margin of the eyes slightly in advance of that of the vertex; greatest width of the head nine tenths the pronotal humeral width and slightly more than eight times the anterior width of the vertex; synthlipsis wide, at

least two thirds the anterior width of the vertex; along the median longitudinal axis the head is approximately one half the length of the pronotum. Pronotum with its humeral width twice its median length; lateral margins diverging and approximately one half the median length; posterior margin convex, medianly emarginate; dorsal surface with a faint median depression and a concavely curved ridge on either side, halfway between the median line and the lateral margin. Facial tubercle with two tufts of hairs, one on either side of the median line, which extend posteriorly to the base of the labrum. Labrum with its basal width slightly more than its median length, and with its apex more or less accuminate. Rostral prongs (Pl. XLVI, fig. 54b) with their length slightly less than that of the third rostral segment; apex accuminate. Chaetotaxy of the male front leg as shown on Plate XLVI. The relative length of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	119	86	..
Middle leg	100	84	33	22
Hind leg	100	77	30	25

Female structural characteristics.—As viewed from above, the outline of the head is rounded with its greatest width approximately nine tenths the pronotal humeral width and slightly more than six times the anterior width of the vertex; synthlipsis wide, two thirds the anterior width of the vertex; along the median longitudinal axis the head is less than one half the pronotal lengths. Pronotum with humeral width twice its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate; dorsal surface with same markings as male only fainter. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	126	56	38
Middle leg	100	83	36	21
Hind leg	100	79	33	25

Location of types.—Male holotype, female allotype, nine male, six female paratypes, Rambha, Ganjam Dist. Madras, India, IX-20-13, Annandale, in the Indian Museum at Calcutta. Other paratypes are as follows: In the Snow Entomological Collection: Seven males, seven females (same collection data as above); one male, one female, Barkuda, Chilka Lake, Madras Pres., India, VIII-19, F. H. Gravely; one male, Java, VIII-1939. In the Indian Museum at Calcutta: One male, Waltair, India, I-27-21; eight females, Barkuda,

Chilka Lake, Ganjam Dist., Madras, India, IX-23-19, N. A.; two males, Rambha, Ganjam, fr. an ornamental fountain, XII-30-18, N. A.; three males, one female, Bangalore, S. India, ca 3000 ft., X-13-10, Annandale; two females, Markiuppon, S. India, ca 2500 ft.; one male, Barkul, Puri Dist. Orissa, India, XI-9 to 13-12, Gravely; one female, Lucknow, I-16-13, Mus. Collr. R. H.; one female Satapare, Lake Dhilha, Orissa, IV-16-13, Annandale; two females, Berhampur Murshidabad, Bengal, Sept. '12, Southwell. In the Usinger Collection; two males, one female, Java, VIII-1939.

Comparative notes.—This species is of about the same size and superficial appearance as *Anisops stali* Kirkaldy. It has, however, two tufts of hairs on the facial tubercle that are lacking on the facial tubercle of the latter species. Also *A. stali* has a slightly depressed frons and a faint anterior cephalic projection, both are lacking on *A. barbata.* For comparison of the chaetotaxies of the male front legs see Plate XLVI, fig. 54a and Plate XXXVII, fig. 9a.

Data on distribution:

BURMA

S. Shan States, Yawaghee, Heho, 3800′, III-7-17, Gravely (F. H. Snow Coll.).

INDIA

Kalka, base of Simla Hills, 2400′, VII-16-11, one male, two females (F. H. Snow Coll.).

S. India, Bangalore, 3000′, X-16-10, Annandale, three males, one female (F. H. Snow Coll.).

Bengal, Madhupur, IV-28-to V-7-11, C. Paiva, nine males, four females (F. H. Snow Coll.).

India, Kalka, base of W. Himalayas, V-16-11, Annandale, three males, one female (F. H. Snow Coll.).

Madras, Ganjam Dist., Rambha, IX-20-13, Annandale, nine males, fifteen females (F. H. Snow Coll.).

Patiola State Dhurampur Kooa, base of Simla Hills, VII-2-11, one female (F. H. Snow Coll.).

Brindia, Pulney Hills, L. V. Newton, S. J., two males, three females (Bueno Coll. of F. H. Snow Coll.).

JAVA

Java, Le Moult, one female (Bueno Coll. of F. H. Snow Coll.).

FORMOSA

Formosa one male (F. H. Snow Coll.).

Anisops grandis Poisson

(Pl. XLV, fig. 50)

1937. *Anisops pellucens grandis* Poisson. Ann. Soc. Ent. France, vol. XVI, p. 130.

Size.—Males, length 9.0 mm.-9.3 mm., greatest body width 2.7 mm.; females, length 9.3 mm.-10.0 mm. greatest body width 2.7 mm-3.0 mm.

Shape.—Large, fusiform species; greatest body width midway the body length.

Color.—General body color testaceous. Eyes brown. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head eight tenths the pronotal humeral width and seven to eight times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior width of the vertex; along the median longitudinal axis the head is almost one half the length of the pronotum. Pronotum with its humeral width almost twice the median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised. Labrum with its basal width one and three tenths the median length; apex rounded. Rostral prong (Pl. XLV, fig. 50b) slightly shorter than the third rostral segment; apex more or less accuminate. Stridulatory comb (Pl. XLV, fig. 50c) of approximately twenty teeth. Chaetotaxy of the male front leg as shown on Plate XLV. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	127	91	..
Middle leg	100	89	33	22
Hind leg	100	82	32	29

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal humeral width and slightly more than five times the anterior width of the vertex; synthlipsis wide, two thirds the anterior width of the vertex; along the median longitudinal axis the head is one half the length of the pronotum. Pronotum with its humeral width slightly more than twice the median length; lateral margins diverging and almost one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	128	55	36
Middle leg	100	89	33	25
Hind leg	100	78	28	23

Location of types.—The type material for *Anisops pellucens grandis* Poisson from Tananarive Madagascar is in the Paris Museum.

Comparative notes.—This species is very closely related to *Ani-*

sops pellucens Gerst. and can be successfully separated only on the basis of the males. The males of *A. grandis* have a narrower anterior width of the vertex, one seventh to one eighth the greatest width of the head, instead of one sixth as in *A. pellucens.* Also the males lack the apical spine on the inner surface of the anterior margin of the fore tibia as found on *A. pellucens.* The rostral prongs are shaped somewhat differently, that of *Anisops pellucens* being much wider in its apical half than that of *A. grandis.*

Remarks.—I am raising *Anisops pellucens grandis* Poisson to specific level on the basis of the above mentioned differences from *A. pellucens.*

Data on distribution:

MADAGASCAR

Tananarive, 1921, R. Decary, one male, one female (F. H. Snow Coll.); one male, one female (Paris Museum).

Madagascar, 1899, Grandidier, four females (Paris Museum).

Marais du Fimerna, 1905, F. Geay, five females (Paris Museum).

Region de L'Androy Ambouvombe, I-15-1901, Dr. F. DeCorse, one female (Paris Museum).

Madagascar, two males, two females (U. S. Nat. Mus.).

Madagascar, Diego Suarez, 1893, Ch. Alluaud, one male (U. S. Nat. Mus.).

Betaimisaratha, exchange fr. Horvath, two females (F. H. Snow Coll.).

Madagascar, one male, six females (Bueno Coll. of F. H. Snow Coll.).

Anisops tanalensis n. sp.*

(Pl. XLIV, fig. 46)

Size.—Males 5.8 mm.-6.3 mm., greatest body width 1.6 mm.-1.9 mm.

Shape.—Subfusiform species; greatest body width midway the length of the body.

Color.—General facies dark gray. Eyes dark brown. Vertex and pronotoum testaceous, the latter may have a brown median spot. Scutellum black with lateral margins testaceous or testaceous with only apical half black. Hemelytra hyaline and appear the black color of the dorsal body surface. Legs stramineous. Abdominal venter dark brown or black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the anterior margin almost straight; greatest width of head almost as wide as the pronotal width and slightly more than seven times the anterior width of the vertrex; synthlipsis wide, one half the anterior width of the vertex; along the

* No females were present in the material at my disposal.

median longitudinal axis the head is two thirds the length of the pronotum with its humeral width almost twice the median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised. Labrum long; median length almost equal to the basal width; apex rounded. Rostral prong (Pl. XLIV, fig. 46b) longer than the third rostral segment; apex accuminate. Anterior femur rounded at the apex. Stridulatory comb (Pl. XLIV, fig. 46c) of approximately thirteen teeth; apical three shorter than basal ten. Chaetotaxy of the male front leg as shown on Plate XLIV. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	115	92	..
Middle leg	100	85	40	28
Hind leg	100	86	31	34

Location of types.—Male holotype, Madagascar, Foret Tanala, Reo de Ranonafana, Anjorojoro, 1901, Ch. Alluaud, in the Paris Museum. Paratypes are as follows: one male, Madagascar, Diego-Suarez, 1901, Ch. Alluaud, in the Paris Museum; one male (same collection data as type) in the Francis H. Snow Collection.

Comparative notes.—This species appears closely related to *Anisops alluaudi* Poisson and differs from it by the fact that the males have the apex of the front femur rounded, whereas that of *A. alluaudi* is accuminate.

Data on distribution.—Known only from type series.

Anisops windi n. sp.

(Pl. XLV, fig. 48)

Size.—Males, length 5.2 mm.-5.4 mm., greatest body width 1.4 mm.; females, length 4.8 mm., greatest body width 1.3 mm.

Shape.—Small, slightly fusiform species, greatest body width almost midway the body length.

Color.—Eyes brown. Vertex and pronotum testaceous. Scutellum testaceous, orange, or black with lateral margins crimson. Hemelytra hyaline and may appear black or stramineous, depending on the color of the underlying color of the dorsal body surface. Hemelytra may be tinged with crimson along scutellar margins. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the anterior margins of the eyes ex-

tending slightly beyond that of the vertex; greatest width of the head nine tenths the pronotal humeral width, approximately nine times the anterior width of the vertex; synthlipsis wide, nine tenths the anterior width of the vertex; along the median longitudinal axis the head is four fifths the length of the pronotum. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and slightly more than twice its median length; posterior margin convex, medianly emarginate. Facial tubercle only slightly raised; bearing long procumbent hairs. Labrum hairy; basal width equal to median length; apex rounded. Rostral prong (Pl. XLV, fig. 48b) longer than third rostral segment; apex accuminate. Stridulatory comb (Pl. XLV, fig. 48c) of approximately seventeen, almost even-length, teeth. Chaetotaxy of the males front leg as shown on Plate XLV. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	127	82	..
Middle leg	100	79	38	27
Hind leg	100	86	30	36

Female structural characteristics.—Viewed from above, the outline of the head is rounded with its greatest width nine tenths the pronotal humeral width and five times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior width of the vertex; along the median longitudinal axis the head is three fifths the pronotal length. Pronotum with its humeral width almost twice the median length; lateral margins diverging and one half the median length; postertior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	109	*	*
Middle leg	100	88	44	26
Hind leg	100	81	31	31

Location of types.—Male holotype, female allotype, Australia, N. Queensland, Barren River near Redlyach, IX-21-28, R. G. Wind, in the Snow Entomological Collection. One male paratype, Rocky Scrub, McIlwraith Rge. C. York, Queensland, Australia, Harvard Exped., Darlington, in the Harvard Museum of Comparative Zoology.

Comparative notes.—This species appears somewhat similar to *A. barrenesis* n. sp. from which it can be distinguished on the basis

* Lacking on the female at my disposal. Specimen mutilated.

of the males which lack the greatly swollen anterior femur as found on the latter.

Data on distribution.—Known only from type series.

Anisops leucothea Esaki

(Pl. XLV, fig. 47)

1926. *Anisops leucothea* Esaki, Insects of Samoa, Part II, pp. 76-80, text fig. 6.
1933. *Anisops leucothea*, Lundblad, Arch. für Hydrob., Suppl. vol. XII, p. 145 (a list of Indo-australian and Pacific forms of this genus).

Size.—Males, length 7.2 mm.-7.3 mm., greatest width of body 2.1 mm.-2.2 mm.; females, length 6.9 mm.-7.6 mm., greatest body width 1.5 mm.-2.3 mm.

Shape.—Robust, slightly fusiform species; lateral margins in anterior half of body almost parallel, converging in posterior half of body.

Color.—General facies stramineous. Eyes brown. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the head is broad with its outline rounded; greatest width of head equal to the pronotal humeral width and seven to eight times the anterior width of the vertex; synthlipsis wide, over one half the anterior width of the vertex; along the median longitudinal axis the head slightly more than half the length of the pronotum. Pronotum with its humeral width one and two thirds its median length; lateral margins more or less parallel with their length two thirds the median length; posterior margin convex, medianly emarginate. Facial tubercle only slightly raised. Labrum long, median length slightly more than its basal width; apex rounded; base of the labrum set with long hairs that extend the full length of the labrum. Rostral prong (Pl. XLV, fig. 47c) slightly shorter than the third rostral segment; apex acuminate. Stridulatory comb (Pl. XLV, fig. 47b) of approximately nineteen teeth. Chaetotaxy of the male front leg as shown on Plate XLV. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	103	72	..
Middle leg	100	81	48	27
Hind leg	100	80	25	28

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal humeral width and six times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior

width of the vertex; along the median longitudinal axis the head is three fifths as long as the pronotum. Pronotum with humeral width slightly more than twice the median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	114	57	36
Middle leg	100	85	42	37
Hind leg	100	81	28	28

Location of types.—Male and female types, six male and eight female paratypes, Upolu: Mulifanua, XI-9-1925, in the British Museum.

Comparative notes.—Very similar to *Anisops occipitalis* Breddin and only the males can be relied on for accurate separation. On the males of *A. leucothea* Esaki the width of the head is equal to the pronotal humeral width and the lateral margins of the pronotum are almost parallel whereas on the males of *A. occipitalis* the head is only nine tenths the pronotal humeral width and the lateral pronotal margins are diverging. Also the head of the former is seven to eight times the anterior width of the vertex while in the latter the head is approximately six times the anterior width of the vertex.

Data on distribution:

Wallis Island

Uvea, Lake Kikila, 1903, Dr. Joly, one male (compared with type by Dr. Hungerford), two females (F. H. Snow Coll.); one male five females (Paris Museum).

Anisops doris Kirkaldy

(Pl. XLVI, fig. 53)

1904. *Anisops doris* Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 112, 132.

1923. *Anisops doris,* Hale, Rec. South Australian Mus., vol. II, no. 3, p. 402-403, text fig. 364, Pl. XI, fig. 11 (evidently had a mixture of two or more species).

*1924. *Anisops doris,* Hale, South Australian Nat., vol. V, no. 4, p. 135 (note on migration).

1933. *Anisops doris.* Lundblad, Arch. für Hydrob., Suppl. vol. XII, p. 145 (a list of Indo-australian and Pacific forms of this genus).

1934. *Anisops doris,* Hungerford, Bull. Brooklyn Ent. Soc., vol. XXIX, p. 68 (ecological note; inaccurate as composite species, neither of which *A. doris* Kirkaldy).

*1935. *Anisops doris,* Hale, Trans. Royal Soc. South Australia, vol. LIX, p. 249 (ecological note).

Size.—Males, length 7.5 mm.-7.8 mm., greatest body width 1.8 mm.; females, length 7.2 mm.-7.4 mm., greatest body width 1.8 mm.-1.9 mm.

* Questionable, due to previous inaccuracy in determination.

Shape.—Broad-headed, fusiform species; greatest body width about midway the body length.

Color.—General facies stramineous. Eyes brown. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width of the head slightly more than the pronotal humeral width and about eight and one half times the anterior width of the vertex; synthlipsis wide, at least one third the anterior width of the vertex; along the median longitudinal axis the head is nine tenths the length of the pronotum. Pronotum with its humeral width slightly less than twice its median length; lateral margins slightly convex, almost parallel; two thirds the median length of the pronotum. Frons narrow, about the width of the synthlipsis; facial tubercle only slightly raised. Labrum with its basal width slightly more than its median length; apex rounded. Rostral prong (Pl. XLVI, fig. 53b) shorter than the third rostral segment; apex accuminate. Stridulatory comb (Pl. XLVI, fig. 53c) of approximately fifty-four closely appressed teeth. Chaetotaxy of the front leg as shown on Plate XLVI. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	131	78	..
Middle leg	100	80	33	27
Hind leg	100	81	30	35

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head nine tenths the pronotal humeral width and six times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is two thirds the median length; lateral margins diverging and three fourths the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:*

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	123	56	35
Middle leg	100	89	38	30

Location of types.—Male type, two male and two female cotypes, Australia, Victoria, Alexandria, F. L. Billinghurst in the Kirkaldy collection of the Snow Entomological Collection.

* Neither of the two females available for study possessed hind legs.

Comparative notes.—This species is about the same size as *Anisops gratus* Hale. However, the two may be readily separated on the basis of the males which in *A. doris* Kirkaldy have the head greater in width than the pronotum humeral width and the anterior width of the vertex is greatly reduced, slightly less than one eighth the width of the head, whereas in *A. gratus* the greatest width of the head is only nine tenths the pronotal humeral width and the anterior width of the vertex is at least one fifth the greatest width of the head.

Data on distribution:

Australia

Victoria, Bacchus Marsh, I-9-14, one male, two females (Bueno Coll. of F. H. Snow Coll.).

Anisops wakefieldi White

(Pl. XLVII, fig. 55; Pl. LVII, fig. 106)

1878. *Anisops wakefieldi* White, The Entomologist Month. Mag., vol. XV, p. 161.
1897. *Anisops wakefieldi,* Hutton, Trans. New Zealand Inst., vol. XXX, pp. 179-180.
1904. *Anisops wakefieldi,* Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 111, 132.
1908. *Anisops wakefieldi,* Kirkaldy, Trans. New Zealand Inst., vol. XLI, p. 27 (ecological note).
1914. *Anisops wakefieldi,* Myers, Trans. New Zealand Inst., vol. 56, pp. 468-469.
1933. *Anisops wakefieldi,* Lundblad, Arch. für Hydrob., Suppl. vol. XII, p. 146 (a list of Indo-australian and Pacific forms of this genus).

Size.—Males, length 7.5 mm., greatest body width 1.9 mm.; females, length 8.1 mm.-8.4 mm., greatest body width 2.1 mm.-2,2 mm.

Shape.—Subfusiform species; lateral margins of the anterior third of the body almost parallel, only slightly converging; lateral margins strongly converging in the posterior two thirds of the body.

Color.—Brown form: General facies stramineous. Eyes brown. Abdominal venter dark brown with keel and segmental margins of the connexivum and stramineous. *Dark form:* General facies gray. Eyes brown. Vertex and pronotum testaceous, the latter with the posterior half hyaline and appears black as it overlies the black anterior portion of the scutellum. Scutellum black with its lateral margin stramineous. Hemelytra hyaline and appear dark gray as they overlie the black dorsal body surface. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with its greatest width nine tenths the pronotal humeral width and slightly more than four times the anterior width of the vertex; synthlipsis wide, three fifths the anterior width of the vertex; along the median longitudinal axis the head is almost

one half the length of the pronotum. Pronotum with its humeral width one and one half its median length; lateral margins diverging and one-half the median length; posterior margin convex, medianly emarginate. Facial tubercle swollen into a ventrally directed triangular eminence, with its apex accuminate. Labrum with its basal width only slightly more than its median length; apex rounded. Rostral prong (Pl. LVII, fig. 106) greatly reduced, only one fourth the length of the third rostral segment; apex truncate. Stridulatory comb (Pl. XLVII, fig. 55b) of approximately eighteen teeth. Chaetotaxy of the male front leg as shown on Place XLVII. The relative lengths of the parts of the legs are as follows:*

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	110	70	..

Female structural characteristics.—Viewed from above, the outline of the head is rounded, with its greatest width eight to nine tenths the pronotal humeral width and four times the anterior width of the vertex; synthlipsis wide, two thirds the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one third the length of the pronotum. Pronotum with its humeral width one and three fourths its median length; lateral margins diverging and less than one half the median length; posterior margin convex, medianly emarginate. Facial tubercle swollen to form a triangular shaped eminence as in the males, but not as large or as accuminate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	102	46	38
Middle leg	100	83	35	24
Hind leg	100	80	31	31

Location of types.—White's type material from Canterbury and Otago, New Zealand in the Perth Museum.

Comparative notes.—This species closely resembles *A. assimilis* White. However, the pronotum of the male of the latter species has its lateral margins almost parallel whereas in *A. wakefieldi* the pronotal lateral margins are diverging. Also the males of the latter lack the greatly swollen facial tubercle as found on the former.

Data on distribution:

NEW ZEALAND

Queenstown, 1875, Hutton, one male, (F. H. Snow Coll.).
Nelson, 1876, Filhal, two females (F. H. Snow Coll.).
New Zealand, one female (F. H. Snow Coll.).

* Only the front leg was intact on the single male specimen at my disposal.

Anisops hancocki Hutchinson

(Pl. XLVI, fig. 52; Pl. LV, fig. 96)

1928. *Anisops hancocki* Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. I, pp. 163-164, text fig. 7.

1933. *Anisops hancocki*, Hutchinson, Internat. ges. Hydrob. und Hydrog., vol. 28, pt. 5/6, p. 462 (ecological note).

Referring to this species also:

1939. *Anisops murati*, Poisson, Bull. Soc. Ent. France, vol. 44, pp. 43-44, text figs. 2, 3.

Size.—Males, length 6.3 mm.-6.9 mm., greatest body width 1.9 mm.-2.3 mm.; females, length 6.4 mm.-6.9 mm., greatest body width 1.9 mm.-2.2 mm.

Shape.—Robust, fusiform species; greatest body width about midway the body length.

Color.—General facies brown. Eyes brown. Vertex, pronotum and scutellum testaceous, the latter may be brown with only apex testaceous and may have its lateral margins red. Hemelytra hyaline and appear dark brown due to the brown color of the dorsal body surface. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous. One specimen is flavus, probably a teneral form.

Male structural characteristics.—Viewed from above, the anterior margin of the head is almost straight; laterally curved; greatest width of head nine tenths the pronotal humeral width and four and one half times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior width of the vertex; along the median longitudinal axis the head is short, less than one half the length of the pronotum. Pronotum with its humeral width twice its median length; lateral margins diverging and one half the median length. Posterior margin convex, medianly emarginate. Facial tubercle excavate; lateral margins carinate. Labrum broad; basal width one and two thirds the median length; apex rounded; a long tuft of hairs at each basal angle. Rostral prong (Pl. LV, fig. 96) shorter than third rostral segment; apex more or less rounded. Stridulatory comb (Pl. XLVI, fig. 52b) of approximately ten teeth which decrease in length at the apex. Keel of the second abdominal segment enlarged laterally and excavate medianly; lateral margins carinate and bearing long erect hairs; excavation lined with short procumbent hairs. Connexivum of the third abdominal segment with a row of nodules on its inner margin extending from base to apex; basal two nodules greatly enlarged. Chaetotaxy of the male front leg as shown on Plate XLVI. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	108	87	..
Middle leg	100	83	42	29
Hind leg	100	80	31	31

Female structural characteristics.—Viewed from above the outline of the head is rounded; greatest width of head eight tenths the pronotal humeral width and almost four times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the length of the pronotum. Pronotum with its humeral width two and one third the median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	118	57	28
Middle leg	100	81	50	23
Hind leg	100	81	33	33

Location of types.—Male type and one male paratype, Uganda, Kampala, III-20-1927, G. L. Hancock, in the British Museum.

Comparative notes.—This species is very similar to *A. psyche* Hutchinson and differs from it by having the fore femur of the male greatly enlarged dorso-ventrally just before the base, a condition lacking in *A. psyche*. For comparison of the chaetotaxies of the front legs of the males see Plate XLVI, fig. 52a and Plate XLIII, fig. 38a.

Remarks.—*A. murati* Poisson, according to the drawings and description of Poisson appears to be identical in every respect to *Anisops hancocki*. So I am placing this species as a synonym of the later.

Data on distribution:

AFRICA

Uganda, Kampala, XI-20-1929, G. E. Hopkins, one male (F. H. Snow Coll.).

Orient. Angl. Sambourou, Wa-Nyika, 1904, Ch. Alluaud, one male (F. H. Snow Coll.).

East Africa, IV-21-1949, F. X. Williams, two males (Harv. Mus. Comp. Zool.).

Soudan, Nioro, 1909, F. de Zeltner, one male (Paris Museum).

Sudan, Rock pool, R. Yei Equatoria, Dec. 11, 1937, J. G. Myers, one male, two females (Brit. Mus.).

Ogaden, Ouabi-Chebeli, Imi Mission, 1903, Du Bourg du Bozas, one male (Paris Museum).

Anisops decipiens Hutchinson

(Pl. XLVIII, fig. 62)

1930. *Anisops decipiens* Hutchinson, Proc. Zool. Soc. London, vol. XXIX, pt. 2, pp. 448-449, text figs. 4, a, b, c.

1932. *Anisops decipiens*, Hutchinson, Proc. Zool. Soc. London, vol. XXXI, pt. 1, pp. 125-126 (ecological note).

Size.—Males, length 6 mm., greatest body width 1.8 mm.; females, length 7.4 mm., greatest body width 2.1 mm.

Shape.—Robust, slightly fusiform species; greatest width at humeral margins of pronotum.

Color.—General facies dark brown. Eyes dark brown. Vertex and pronotum testaceous, the latter irregularly hyaline and with a median brown spot. Scutellum dark brown, lateral margins crimson. Hemelytra hyaline and appearing the dark brown color of the underlying dorsal body surface. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the head is short with the outline rounded, anterior margin almost straight; greatest width of the head nine tenths the pronotal humeral width and five times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one third the length of the pronotum. Pronotum with its humeral width twice the median length; lateral margins diverging and less than one half the median length; posterior margin convex, medianly emarginate. Facial tubercle only slightly raised. Labrum with its basal width almost one and one third the median length; apex rounded. Rostral prong (Pl. XLVIII, fig. 62c) equal to the length of the third rostral segment; apex accuminate. Stridulatory comb (Pl. XLVIII, fig. 62b) of approximately seven stout teeth which increase in length at the middle. Chaetotaxy of the front leg as shown on Plate XLVIII. The relative lengths of the parts of the legs are as follows:*

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	119	..	..
Middle leg	100	81	38	23

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head eight tenths the pronotal humeral width and slightly more than four times the

* Unfortunately, the single male specimen in my material was minus the fore tarsi and the hind legs.

anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is one half the length of the pronotum. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and almost one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:†

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	122	56	33
Middle leg	100	82	36	21

Location of types.—Male type, female allotype, and one female paratype, Asbysinnsi, Wouranboulchi, XI-4th to 7th-1926, J. Omer-Cooper, in the British Museum.

Comparative notes.—Superficially similar to *Anisops ares* Hutchinson from which it distinguishes itself by the fact that the males lack the dorso-ventrally expanded front femur with the curved apex as found on the males of *A. ares.*

Data on distribution:

AFRICA

Abyssinia, Djem-Djem Forrest, circa. 8000′, X-21-1926, J. Omer-Cooper, one male, one female, gift to H. B. H. from G. E. Hutchinson (F. H. Snow Coll.).

Anisops barrenensis n. sp.

(Pl. XLIV, fig. 42)

Size.—Males, length, 4.8 mm.-5.1 mm., greatest body width 1.4 mm.-1.6 mm.; females, length 4.8 mm.-5.1 mm., greatest body width 1.4 mm.-1.6 mm.

Shape.—Small, robust, fusiform species; greatest body width midway the body length.

Color.—General facies gray. Eyes brown. Vertex may be tinged with orange. Hind margin of pronotum may be hyaline and appear black as it overlies the black anterior portion of the scutellum. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the anterior margin almost straight; greatest width of head nine tenths the pronotal humeral width; four and one half times the anterior width of the vertex; synthlipsis

† The female specimen in my material was minus the hind legs.

wide, slightly more than one half the anterior width of the vertex; along the median longitudinal axis the head is slightly less than one half the pronotal length. Pronotum with its humeral width slightly less than twice the median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate; dorsal surface with a faint median ridge and a convexly curved ridge on each side between median line and lateral margin. Facial tubercle slightly raised and bearing a few hairs. Posterior margin of third rostral segment covered for almost its entire length by an extension of the second rostral segment (Pl. XLIV, fig. 42b). Rostral prong accuminate. Labrum covered with small fine hairs; basal width only slightly greater than median length; apex truncate. Stridulatory comb (Pl. XLIV, fig. 42c) of approximately sixteen teeth. Chaetotaxy of the male front leg as shown on Plate XLIV. The relative lengths of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	116	83	..
Middle leg	100	81	39	28
Hind leg	100	86	31	36

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal humeral width, slightly more than four times the anterior width of the vertex; synthlipsis wide, more than one half the anterior width of the vertex; along the median longitudinal axis the head is one half the pronotal length. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate, dorsal ridges as in the males. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	116	50	28
Middle leg	100	80	37	26
Hind leg	100	86	31	36

Location of types.—Male holotype, female allotype, twenty-one male and twenty-nine female paratypes, N. Queensland, Barren River nr. Barren Waters, IX-9-28, R. Wind, in the Snow Entomological Collection. Other paratypes are as follows. In the Harvard Museum of Comparative Zoology: one male, two females, Queensland, Australia, Coen C. York, May 32, Darlington, Harv. Austrl. Exped.

Comparative notes.—Very similar to *A. hackeri* n. sp. from which it differs by the fact that the males of the latter do not have the greatly expanded front femur as found on *A. barrenensis.*

Data on distribution.—Known only from type series.

Anisops hungerfordi Poisson

(Pl. XLVI, fig. 51)

1935. *Anisops hungerfordi* Poisson, Mus. Nat. Hist. Nat., vol. III, p. 213, text fig. 28, A, B. C.

Size.—Males, length 5.1 mm., greatest body width 1.5 mm.; females, length 5.4 mm., greatest body width 1.5 mm.

Shape.—Small, robust, slightly fusiform species; greatest body width about midway the body length.

Color.—General facies stramineous. Eyes brown. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head nine tenths the pronotal humeral width and six times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is almost one half the length of the pronotum; lateral margins diverging and almost one half the median length; posterior margin straight. Facial tubercle flat. Labrum long with its median length almost one and one third the median length; apex rounded. Rostral prong (Pl. XLVI, fig. 51b) longer than third rostral segment; apex rounded. Stridulatory comb (Pl. XLVI, fig. 51c) of approximately fifteen teeth which decrease in length in apical half. Chaetotaxy of the male front leg as shown on Plate XLVI. The relative lengths of the parts of the legs are as follows:*

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	121	81	..
Middle leg	100	76	37	27

Female structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width nine tenths the pronotal humeral width and four to five times the anterior width of the vertex; synthlipsis wide, slightly more than one third the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the pronotal length. Pronotum with its humeral width slightly more than twice the median length; lateral margins diverging and almost one half the median length;

* Hind leg not complete on single male specimen in my material.

posterior margin straight. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	117	50	33
Middle leg	100	76	37	28
Hind leg	100	91	32	32

Location of types.—Type material from Bourille, Ethiopia in the Paris Museum.

Comparative notes.—This species is very similar to *A. apicalis* Stål and differs from it primarily by the fact that the wings are not brachypterous; also the scutellum is larger, its basal width only one and one fourth the median length instead of one and three fourths the median length as in *A. apicalis.*

Data on distribution:

AFRICA

Belgian Congo, Mucosa, XI-1939, H. S. Bredo, one male, two females (Roy. Mus. Nat. Hist. Belg.).

Belgian Congo, Mucosa, VIII-3-1927, H. H. Bredo, two females (Roy Mus. Nat. Hist. Belg.).

Belgian Congo, Elizabethville, I-10-1938, H. S. Bredo (Roy. Mus. Nat. Hist. Belg.).

Anisops ares Hutchinson

(Pl. XLVII, fig. 57)

1926. *Anisops ares* Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. I, pp. 104-106, text fig. 8.

1933. *Anisops ares*, Hutchinson, Internat. ges. Hydrob. und Hydrog., vol. 28, pt. 5/6, p. 462.

Referring to this species also:

1928. *Anisops coxalis*, Poisson, Bull. Soc. Ent. France, no. 4, p. 74.

1929. *Anisops coxalis*, Poisson, Fauna des Colonies Francaises, vol. III, pp. 152-154, figs. 20, 21.

1948. *Anisops coxalis*, Poisson, Rev. Francaise Ent., vol. XV, p. 168 (ecological note).

Size.—Males, length 6.5 mm.-7.1 mm., greatest body width 1.9 mm.-2.1 mm.; females, length 6.0 mm.-6.3 mm., greatest body width 1.2 mm.-1.4 mm.

Shape.—Robust, slightly fusiform species; greatest body width at the humeral width of the pronotum.

Color.—Light form: General facies stramineous. Eyes brown. Apical third of hemelytra dark brown. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous. *Dark form:* Eyes brown. Vertex brown. Vertex and pronotum testaceous, the latter may be hyaline on its posterior half and appear the black color of the underlying scutellum. Scutellum dark brown or black. Hemelytra hyaline with

posterior third dark brown or black; hyaline areas appear dark brown or black depending on the underlying color of the dorsal body surface. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the lateral margins of the head are curved and the anterior margin almost straight; greatest width of the head only slightly narrower than the pronotal humeral width and six times the anterior width of the vertex; synthlipsis wide, at least one half the anterior width of the vertex; along the median longitudinal axis head is short, only one third the pronotal length. Pronotum long, humeral width one and two thirds the median length; lateral margins slightly diverging and one half the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised. Labrum short, basal width slightly more than the median length; apex rounded. Rostral prong (Pl. XLVII, fig. 57b) longer than the third rostral segment; apex accuminate. Fore leg (Pl. XLVII, fig. 57a) with the dorsal and ventral margins of the femur almost parallel for the basal three fourths of their length; apex rounded; stridulatory comb (Pl. XLVII, fig. 57c) of approximately eleven teeth, the apical five slightly longer than the basal six. Chaetotaxy of the male front leg as shown on Plate XLVII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	105	73	..
Middle leg	100	82	33	24
Hind leg	100	82	33	30

Female structural characteristics.—Viewed from above, the outline of the head is curved laterally and almost straight on its anterior margin; greatest width of head nine tenths the pronotal humeral width and six times the anterior width of the vertex; along the median longitudinal axis the head is one half the length of the pronotum. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	117	56	33
Middle leg	100	77	35	27
Hind leg	100	86	37	37

Location of types.—Male type, female allotype, three male and two female paratypes Uganda, Kampala, III-20-1927, in the British Museum.

Comparative notes.—Very similar to *Anisops varia* Fieber but can easily be separated on the basis of the males. The males of the latter species have a much shorter pronotum which is twice the length of the head instead of three times the length of the head as in *A. ares*. Also, the male front femur of *A. varia* has its dorsal and ventral margin converging from the base, instead of the almost parallel condition as found on *A. ares*.

Remarks.—*Anisops ares* Hutchinson was described from a form occurring in Uganda and *A. coxalis* was described from Cameron. The material at my disposal reveals that *A. ares* is a species of wide distribution occurring in South Africa, Tanganyika, Uganda west to Cameron, and that *A. coxalis* is a synonym of *A. ares*.

Data on distribution:

Africa

South Africa, Natal, Mahira Forrest, IX-1920, through R. A. Drummer, four males, five females (U. S. Nat. Mus.).

Uganda, Kampala, I-20-30, G. E. Hopkins, gift to H. B. H. from G. E. Hutchinson, one male, one female (F. H. Snow Coll.).

Tanganyika, Mpala, Oberthur, one male, three females (Paris Museum).

Tanganyika, Amani, Feb. 1948, F. X. Williams, one female (Harv. Mus. Com. Zool.).

Cameroons, W. Africa, Sangmelina, 4-16-32, A. I. Good, fifteen males, twenty females (F. H. Snow Coll.).

Cameroons, W. Africa, Sangmelina, Oct. 17, 1934, A. I. Good, twenty-five males, fourteen females (F. H. Snow Coll.).

Nigeria, Abakaliki, I-26-49, B. Malkin, one male, four females (Calif. Acad. of Science).

Anisops paranigrolineata n. sp.

(Pl. XLVIII, fig. 59)

Size.—Males, length 6.0 mm., greatest body width 5.4 mm.; females, length 6.0 mm.-6.3 mm., greatest body width 1.8 mm.-1.9 mm.

Shape.—Fusiform species, with eyes much wider than the anterior width of the pronotum; greatest body width about midway the body length.

Color.—*Brown form*: General facies stramineous. Eyes brown. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous. *Dark form*: Eyes dark brown. Vertex stramineous. Pronotum testaceous with posterior margin appearing black as it is hyaline and overlies the black anterior margin of the scutellum. Hemelytra hyaline and appearing black as it overlies the black dorsal body surface. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal width, five to six times the anterior width of the vertex; synthlipsis wide, almost nine tenths the anterior width of the vertex; along the median longitudinal axis the head is less than one third the length of the pronotum. Pronotum with its humeral width one and one fourth its median length; lateral margins diverging and almost one half the median length; posterior margin convex; dorsal surface with a faint median ridge and a longitudinal convexly curved ridge on each side, near the lateral margin. Facial tubercle slightly raised and spread out laterally. Labrum greatly reduced in length; basal width almost four times the median length; rounded along anterior margin. Rostral prong (Pl. XLVIII, fig. 59b) shorter than third rostral segment, apex rounded. Anterior femur greatly enlarged dorso-ventrally at base; apex accuminate. Stridulatory comb (Pl. XLVIII, fig. 59c) of approximately eighteen teeth. Chaetotaxy of the male front leg as shown on Plate XLVIII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	132	86	..
Middle leg	100	73	43	25
Hind leg	100	83	33	34

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width nine tenths the pronotal humeral width, though much wider than the anterior width of the pronotum; greatest width of head slightly more than five times the anterior width of the vertex; synthlipsis wide, almost eight tenths the anterior width of the vertex; along the median longitudinal axis the head is almost one third the length of the pronotum. Pronotum with its humeral width one and one half its median length; lateral margins concave and diverging, almost one half the median length; posterior margin convex; dorsal ridges present as in male though somewhat fainter. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	128	57	36
Middle leg	100	74	37	27
Hind leg	100	84	33	33

Location of types.—Male holotype, female allotype, Mahabaleshwar, Satara Dist. India, 4200′, V-13 to 16-12, F. H. Gravely, in the Indian Museum at Calcutta. Other paratypes are as follows. In the Indian Museum at Calcutta: one male, one female, Satara

Dist, Nachal, W. Chats, 2000′, IV-30-12, F. H. Gravely. In the Snow Entomological Collection: two males, two females, Mahabaleshwar, Satara Dist. India, 4200′, V-13 to 16-12, F. H. Gravely.

Comparative notes.—This species is closely related to Anisops *nigrolineata* Lundblad and differs from it in not having its interocular space swollen and extending beyond the margin of the eyes.

Data on distribution:

India

Kumaun, W. Himalayas, Nauhuchia Tal, 4200, V-5-11, S. W. Kemp, one female (F. H. Snow Coll.).

Coimbatore, one male, one female (F. H. Snow Coll.).

Anisops nigrolineata Lundblad

Pl. XLVII, fig. 56; Pl. LVII, fig. 105)

1933. *Anisops nigrolineata* Lundblad, Arch. für Hydrob., Suppl. vol. XII, pp. 145, 160-163, fig. 55.

Size.—Males, length 5.4 mm.-6.3 mm., greatest body width 1.5 mm.-18 mm.; females, length 5.4 mm.-6.6 mm., greatest body width 1.5 mm.-1.8 mm.

Shape.—Fusiform species with greatest body width at apical third of body.

Color.—Dark form: General facies black. Eyes brown. Vertex pronotum testaceous with the latter irregularly hyaline and such areas appear black as they overlie the black scutellum. Scutellum black, may be testaceous on the apical half. Hemelytra hyaline and appear black as it overlies the black dorsal body surface. Legs dark brown. Abdominal venter black with keel and segmental margins of the connexivum brown. *Pale form:* General facies pearlaceous. Eyes brown. Legs stramineous. Abdominal venter black or dark brown with keel and segmental margins of the connexivum pearlaceous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the vertex extending beyond the anterior margins of the eyes; greatest width of the head nine tenths the pronotal humeral width and four to five times the anterior width of the vertex; synthlipsis wide, one half the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one third the length of the pronotum. Pronotum long; humeral width one and two fifths the median length; lateral margins diverging and slightly more than one third the median length; posterior margin convex, medianly emarginate; dorsal surface with a median longitu-

dinal ridge and a convexly curved longitudinal ridge on each side, midway between the median line and the lateral margin. Facial tubercle flat and spread out laterally. Viewed laterally the interocular space protrudes beyond the margins of the eyes from midway the dorsal length to the base of the labrum; flattened on its outer surface. Labrum greatly reduced in length; basal width slightly more than twice its median length; apex rounded. Rostral prong (Pl. LVII, fig. 105) slightly shorter than the third rostral segment; apex truncate. Stridulatory comb (Pl. XLVII, fig. 56b) of approximately twenty-two teeth, the apical fourteen slender and long, more than twice the length of the basal eight. Chaetotaxy of the front leg as shown on Plate XLVII. The relative length of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	125	78	..
Middle leg	100	58	29	24
Hind leg	100	87	30	30

Female structural characteristics.—Viewed from above, the outline of the head is rounded with the vertex extending slightly beyond the anterior margin of the eyes; greatest width of head eight to nine tenths the pronotal humeral width and four to five times the anterior width of the vertex; synthlipsis wide, almost one half the anterior width of the vertex; along the median longitudinal axis the head is one third as long as the pronotum. Pronotum long, humeral width only one and one half the median length; lateral margins diverging and slightly more than one third the median length; posterior margin almost straight, only slightly concave; dorsal surface with the same ridges as found on the males. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	126	54	35
Middle leg	100	74	37	30
Hind leg	100	85	33	34

Location of types.—Type material from Java in the Stockholm Museum.

Comparative notes.—The long pronotum of this species is also a characteristic of *A. thienemanni* Lundblad, another species from Java. However, the pronotum of the males of the latter species has its lateral margins almost parallel whereas in *A. nigrolineata* the pronotal lateral margins are diverging. Also the males of *A. thienemanni* lack the protruding interocular space as found on the males of

this species. For comparison of the male front legs of the two species see Plate XLVII, fig. 56a, and Plate XLVIII, fig. 63a.

Data on distribution:

BURMA

Shingbwiyang, III-7-1944, Lt. L. C. Kuitert, sixteen males, twenty-one females (F. H. Snow Coll.).

Shingbwiyang, XI-15-1944, Capt. L. C. Kuitert, nine males, eight females (F. H. Snow Coll.).

Myitkyina, XI-18-44, Capt. L. C. Kuitert, two males (F. H. Snow Coll.).

Myitkyina, X-3-45, Capt. L. C. Kuitert, one male, (F. H. Snow Coll.).

Myitkyina, V-29-45, Capt. L. C. Kuitert, one female (F. H. Snow Coll.).

Myitkyina, IX-30-45, B. McDermott, two males (F. H. Snow Coll.). Burma, 1944, L. C. Kuitert, one male, two females (F. H. Snow Coll.).

INDIA

Baluchistan, Quetta, 5700′, pond in residence garden, Sta. 3, XI-10, B. S. six males, eleven females (Indian Museum).

Central Province, Puchapur, III-4-19, C. P. and F. H. G., one male, one female (Indian Museum).

Ratnagiri Dist. 400′, pophil, Vashishti, V-1st to 2nd-12, F. H. Gravely, four males (Indian Museum).

Ratnagiri Dist., 0-300′, Chiplum Vashishti, V-3rd to 5th-12, F. H. Gravely, two males (Indian Museum).

Satara Dist., Nechal, W. Ghats, IV-30-12, F. H. Gravely, one male, two females (Indian Museum).

Satara Dist., Medha Yanna Valley, 2200′, IV-17th to 23rd-12, F. H. Gravely, three males, four females (Indian Museum).

Satara Dist., Relvak, Koyna Valley, 2000′, IV-28th to 30th-12, F. H. Gravely, one female (Indian Museum).

Bengal, Rangamati, Chittagong Hill Tracts, VII-11th to 16th-15, R. Hodgard, three males, three females (Indian Museum).

S. India, Coimbatore, II-14-13, four males (Bueno Coll. of F. H. Snow Coll.).

Kumaun, W. Himalayas, Sat. Tal., 4500′, V-9 to 10-11, S. W. Kemp, one male (F. H. Snow Coll.).

SIBUYAN ISLAND

Sibuyan Isl. Baker, one male, one female (U. S. Nat. Mus.).

Anisops assimilis White

(Pl. XLVIII, fig. 61)

1878. *Anisops assimilis* White, Entomologists Month. Mag., vol. XV, p. 161.

1897. *Anisops assimilis*, Hutton, Trans. New Zealand Inst., vol. XXX, p. 180.

1904. *Anisops assimilis*, Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 112, 132.

1908. *Anisops assimilis* Kirkaldy, Trans. New Zealand Inst., vol. XLI, p. 27 (a check list of Hemiptera of Maorian subregion).

1926. *Anisops assimilis*, Myers, Trans. New Zealand Inst., vol. 56, pp. 468-469.

1928. *Anisops assimilis*, Esaki, Insects of Samoa, vol. II, p. 79.

1933. *Anisops assimilis*, Lundblad, Arch. für Hydrob., Suppl. vol. XII, pp. 145, 173-174, text fig. 63 (compared with *Anisops thienemanni* Lundblad).

Size.—Males, length 6.6 mm., greatest body width 1.8 mm., fe-

males, length 6.3 mm.-7.8 mm., greatest width of body 1.7 mm.-2.1 mm.

Shape.—Robust, only slightly fusiform species with lateral margins in the anterior half of the body almost parallel-sided and converging in posterior half.

Color.—General facies stramineous. Eyes brown. Posterior half of hemelytra may be hyaline and appear darker as it overlies the dark brown dorsal surface of the abdomen. Legs stramineous. Abdominal venter black or dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—As viewed from above, the outline of the head is rounded with its greatest width equal to the pronotal humeral width and six times the anterior width of the vertex; synthlipsis wide, approximately four fifths the anterior width of the vertex; along the median longitudinal axis the head is less than half the length of the pronotum. Pronotum with its median length three fourths the humeral width; pronotal lateral margins diverging; posterior margin convex, medianly emarginate. Facial tubercle slightly swollen and raised. Labrum arched along median longitudinal line; basal width equal to median length; apex accuminate. Rostral prong (Pl. XLVIII, fig. 61b) with its apex accuminate and its length equal to the length of the posterior margin of the third rostral segment. Anterior leg with dorsal and ventral femoral margins sub-parallel only slightly converging for the basal three fourths of their lengths, apex rounded. Stridulatory comb (Pl. XLVIII, fig. 61c) of approximately twenty-eight teeth, the basal fourteen teeth twice as long as the apical fourteen, with an abrupt decrease in length between the two groups. Chaetotaxy of the male front leg as shown on Plate XLVIII, fig. 61a. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	116	..	..

Unfortunately, the single male specimen that I had for study was rather mutilated, possessing only the femur and tibia of the right fore leg.

Female structural characteristics.—As viewed from above, the outline of the head is rounded with its greatest width nine tenths the pronotal humeral width and four times the anterior width of the vertex; synthlipsis wide, four fifths the anterior width of the vertex; along the median longitudinal axis the head is slightly less than one half the length of the pronotum. Pronotum with its

humeral width slightly less than twice its median length; lateral margins diverging, posterior margin convex, medianly emarginate. The relative length of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	100	62	31
Middle leg	100	80	40	25

Unfortunately I had no specimens which had a complete hind leg.

Location of types.—Type material studied by White is in the Perth Museum, Scotland.

Comparative notes.—By its shape, size and structural characteristics this species appears quite closely related to *Anisops thienemanni* Lundblad. *A. assimilis,* however, possesses a more globose head which is equal to the pronotum in width, whereas in *A. thienemanni,* the width of the head is less than that of the pronotum. For comparison of the chaetatoxy of the male front legs see Plate XLVIII, fig. 61a and Plate XLVIII, fig. 63a.

Data on distribution:

NEW ZEALAND

Queenstown, 1875, Hutton, one male, three females (F. H. Snow Coll.). Silver Stream, 1-14-22, J. C. Myers, four females (F. H. Snow Coll.).

Anisops thienemanni Lundblad

(Pl. XLVIII, fig. 63)

1933. *Anisops thienemanni* Lundblad, Arch. für Hydrob., Suppl. vol. XII, pp. 167-168, text fig. 57.

Referring to this species, also:

1923. *Anisops hyperion,* Hale, South Australian Nat., vol. IV, no. 3, pp. 124-128, text fig. 1, (determined in error).

1923. *Anisops hyperion,* Hale, Rec. South Australian Mus., vol. II, no. 3, pp. 403-412, text fig. 365 (determined in error).

1924. *Anisops hyperion,* Hale, The South Australian Nat., vol. V, no. 4, p. 135 (determined in error).

1930. *Anisops hyperion,* Hutchinson, Proc. Zool. Soc. London, vol. XXIX, p. 145, text fig. 2 (determined in error).

1935. *Anisops hyperion,* Hale, Trans. Royal Soc. South Australia, vol. XIX, p. 249 (determined in error).

Size.—Males, length 6.0 mm.-7.2 mm., greatest body width, 1.6 mm.-2.1 mm.; females, length, 6.0 mm.-6.9 mm., greatest body width 1.8 mm.-1.9 mm.

Shape.—Robust species, anterior half with lateral margins almost parallel, lateral margins converging in posterior half.

Color.—General facies testaceous. Eyes brown. Anterior margin of pronotum may be tinged with orange; may be hyaline on pos-

terior and appear the black color of the underlying anterior margin of the scutellum. Scutellum may be tinged with orange. Hemelytra hyaline and appear black or testaceous depending on the color of the underlying dorsal body surface. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the head is short and broad; outline rounded; greatest width of head almost equal to the pronotal humeral width and four and one half times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior width of the vertex; along the median longitudinal axis the head is one third or less the length of the pronotum. Pronotum long; its humeral width only one and two fifths the median length; lateral margins almost parallel, only slightly diverging and about one half the median length; posterior margin almost straight, medianly emarginate. Facial tubercle only slightly raised. Labrum long, with its median length slightly more than its basal width; apex more or less accuminate. Rostral prong (Pl. XLVIII, fig. 63b) shorter than the third rostral segment; apex accuminate. Anterior femur with dorsal and ventral margins almost parallel for the basal three fourths of their length; dorsal margin curved in apical fourth; apical fifth of inner surface with a curved ridge extending from dorsal margin to almost midway the width. Stridulatory comb (Pl. XLVIII, fig. 63c) of approximately twenty-four to thirty-four teeth. Chaetotaxy of male front leg as shown on Plate XLVIII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	113	74	..
Middle leg	100	75	32	18
Hind leg	100	78	31	31

Female structural characteristics.—Viewed from above, the outline of the head is rounded with the vertex extending slightly beyond the anterior margins of the eyes; greatest width almost nine tenths the pronotal humeral width and four times the anterior width of the vertex; synthlipsis wide, slightly more than one half the anterior width of the vertex; along the median longitudinal axis the head is almost one half the length of the pronotum. Pronotum with its humeral width less than twice its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	128	63	31
Middle leg	100	77	38	23
Hind leg	100	84	32	32

Location of types.—Type material from Diengplateau, Java in the Stockholm Museum.

Comparative notes.—*A. thienemanni* is very closely related to *Anisops assimilis* White, from which it can be separated only on the basis of the males. The head of the male of *A. assimilis* is wider than or at least equal to the pronotal humeral width, whereas in *A. thienemanni* the head of the male is not as wide as pronotal humeral width and the eyes are not as voluminous as in the case of the male *A. assimilis.*

Data on distribution:

AUSTRALIA

New South Wales, Began River, F. Armstrong, via Mr. Deane, eight males, four females (F. H. Snow Coll.).

New South Wales, Imperial Dam, nr. Broken Hill, Fred W. Shepherd, one male, one female (F. H. Snow Coll.).

New South Wales, Imperial Dam, XII-30-1925, F. W. Shepherd, three males, five females (F. H. Snow Coll.).

New South Wales, Concobolin, X-17-'00, three males, two females (Dept. of Agric., N. S. W., Austral.).

Broken Hill, XI-3-43, Chadwick, one male (Dept. of Agric., N. S. W., Austral.).

Broken Hill, in nine mile dam, III-12-44, C. E. Chadwick, two females, one male (Dept. of Agric., N. S. W., Austral.).

Broken Hill, in nine mile dam, IV-23-44, C. E. Chadwick, one male, two females (Dept. of Agric., N. S. W., Austral.).

Broken Hill, III-30-44, C. E. Chadwick (Dept. of Agric., N. S. W., Austral.).

New South Wales, Effing, Sydney, XII-27, Harv. Austral. Exped. Darlington, one female (Harv. Mus. Comp. Zool.).

West Australia, Wiluna, Lake Violet, four males, nine females (Harv. Mus. Comp. Zool.).

West Australia, Rottnest Isl., Oct. '24, Harv. Austral. Exped. P. J. Darlington, two males, nine females (Harv. Mus. Comp. Zool.).

West Australia, Wiluna, Oct. 1, 1931, Harv. Austral. Exped., P. J. Darlington, one male, four females (Harv. Mus. Comp. Zool.).

West Australia, Mullewa, Sept. 13, 1931, Harv. Austral. Exped., P. J. Darlington, two females (Harv. Mus. Comp. Zool.).

West Australia, Geralton, Oct. 11, Harv. Austral. Exped., P. J. Darlington, three females (Harv. Mus. Comp. Zool.).

Adelaide, H. M. Hale, ten males, twelve females (F. H. Snow Coll.).

Swamp near Camberra, III-'32, J. Evans, one male (F. H. Snow Coll.).

South Australia, Port Willunga, H. M. Hale, four males, four females (F. H. Snow Coll.).

South Australia, Adelaide, Nov. '30, Harv. Austral. Exped., P. J. Darlington, one male, one female (Harv. Mus. Comp. Zool.).

South Australia, one female (Harv. Mus. Comp. Zool.).

East Australia, one female (Harv. Mus. Comp. Zool.).

TASMANIA

Tasmania, Hobart, IV-1939, two males, nine females, J. W. Evans (F. H. Snow Coll.).

Anisops nasuta Fieber

(Pl. XLVIII, fig. 60; Pl. LV, fig. 98)

1851. *Anisops nasuta* Fieber, Abhandl. Konigl. bohm. Ges. Wiss., vol. V, pt. 7, pp. 484-485 (Fieber believed this species to be *A. nivea* Fabr.; but he simultaneously named it *A. nasuta* in parenthesis).

1905. *Anisops nasutus,* Breddin, Societas Entomologica, vol. XVII, pp. 153-154.

1933. *Anisops nasuta,* Lundblad, Arch. für Hydrob., Suppl. Vol XII, pp. 145, 168-171, text fig. 58.

1941. *Anisops nasuta,* Hoffmann, Lingnan Sci. Jour., vol. XX, pp. 59-60 (catalogue).

Referring to this species, also:

1901. *Anisops fieberi,* Kirkaldy, The Entomologist, vol. XXXIV, p. 5.

1901. *Anisops fieberi,* Breddin, Abhandl. Nat. Ges. Halle, vol. XXIV, p. 103, (ecological note).

1904. *Anisops fieberi,* Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 116, 132.

1906. *Anisops fieberi,* Distant, Fauna of British India, Rhynchota, III, p. 46.

1923. *Anisops fieberi,* Hale, Rec. South Australian Mus., vol. II, no. 3, pp. 400-401, text fig. 363.

1925. *Anisops fieberi,* Hale, Arch. Zool. utgivet av K. Svenska Vetensk., vol. XVII, no. 26, p. 17 (ecological note).

1926. *Anisops fieberi,* Esaki, Ann. Mus. Nat. Hungarici, vol. XXIV, p. 188 (*A. niveus Matsumura* (*nec.* Fabricius) and *Anisops Kuroiwae* Matsumura synonomized here). (Ecological note also.)

1928. *Anisops fieberi,* Esaki, Insects of Samoa, pt. II, pp. 76-77.

1931. *Anisops fieberi,* China, Jour. Federated Malay states, vol. VIII, p. 261.

1933. *Anisops fieberi,* Wu, Lingnan Sci. Jour., vol. XII, p. 213 (catalogue).

1933. *Anisops fieberi,* Hoffmann, Lingnan Sci. Jour., vol. XII, p. 256 (catalogue).

1935. *Anisops fieberi,* Wu, Catalogue Insectorum Sinensium, vol. II, pp. 575-576.

1905. *Anisops niveus,* (*nec.* Fabr.) Matsumura, Trans. Sappora Nat. Hist. Soc., vol I, p. 28.

1915. *Anisops niveus,* (*nec.* Fabr.) Esaki, Ent. Mag., Kyoto, vol. I, p. 31.

1915. *Anisops Kuroiwae,* Matsumara, Ent. Mag., Kyoto, vol. I, p. 109.

1928. *Anisops nasuta,* Dover, Treubia, vol. X, p. 71 (determined in error).

1928. *Anisops fieberi,* Jaczewski, Ann. Mus. Zool. Polonici, vol. VII, p. 113, Plate XVI, figs. 18, 19, 20, 21 (determined in error, actually *A. genji* Hutchinson).

1915. *Anisops niveus* var. *ogasawarensis,* Matsumura, Ent. Mag., Kyoto, vol. I, pt. 3, p. 109.

1930. *Anisops ogaswarensis,* Esaki, Bull. Biogeog. Soc. Japan, vol. I, no. 3, p. 214.

1933. *Anisops ogasawarensis,* Lundblad, Arch für Hydrob., Suppl. vol. XII, p. 145 (list of Indo-australian and Pacific forms of this genus).

Size.—Males, length 6.0 mm.-7.8 mm., greatest body width 1.5 mm.-1.8 mm.; females, length, 6.0- mm.-6.9 mm., greatest body width 1.4 mm.-1.9 mm.

Shape.—Slightly fusiform species; greatest width of the body about midway the body length.

Color.—General facies stramineous or pearlaceous. Eyes brown. Scutellum may be tinged with orange. Legs stramineous. Ab-

dominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the vertex extending beyond the anterior margins of the eyes; greatest width of the head nine tenths the pronotal humeral width and slightly more than four times the anterior width of the vertex; synthlipsis narrow, less than one third the anterior width of the vertex; along the median longitudinal axis the head is seven tenths the length of the pronotum. Pronotum with its humeral width twice its median length; lateral margins slightly diverging and three fifths the median length; posterior margin convex, medianly emarginate. Frons produced anteriorly into a short cephalic horn; apex of projection with a median oval depression, bordered laterally by a carina on each side; facial tubercle with a median depression. Labrum short and broad; basal width one and one half times the median length; apex broad and rounded; base provided with a few long hairs which extend almost the full length of the labrum. Rostral prong (Pl. LV, fig. 98) shorter than the third rostral segment; apex accuminate. Stridulatory comb (Pl. XLVIII, fig. 60b) of approximately fourteen teeth which increase in length toward the middle. Chaetotaxy of the male front legs as shown on Plate XLVIII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	102	58	..
Middle leg	100	81	34	24
Hind leg	100	81	29	29

Female structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width of the head nine tenths the pronotal humeral width and five times the anterior width of the vertex; synthlipsis wide, slightly more than one third the anterior width of the vertex; along the median longitudinal axis the head is one half as long as the pronotum. Pronotum with humeral width slightly more than twice its median length; lateral margins diverging and one half or more the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	118	42	31
Middle leg	100	82	35	25
Hind leg	100	87	31	31

Location of types.—Fieber's type material was placed in the Berlin Museum. Lundblad (32) makes no mention of the location of the type and Dr. H. B. Hungerford, who, while in Europe in 1928, recorded the location of many types of Anisops species, does not note it as being in the Berlin Museum.

Comparative notes.—This species is superficially similar to *A. batillifrons* Lundblad. However, the cephalic projection of the males is not excavate for its entire length as in *A. batillifrons* and the apex of the projection is not bordered by a raised carina as in the case of the latter. Also the males lack the peculiarly curved middle tarsal claws as found in *A. batillifrons.*

Data on distribution:

NEW GUINEA

Port Moresby, Guigno, 1889, L. Loria, eight males, seventeen females, Kirkaldy Collection (F. H. Snow Coll.).

Erima Astrolobe B. '97, Biro, one female, Kirkaldy Collection (F. H. Snow Coll.).

Rigo, Luglio, 1889, L. Loria, seven males, ten females, Kirkaldy Collection (F. H. Snow Coll.).

CELEBES

Lahendong, two males, one female (Basal Nat. Mus., Switzerland).

FRIENDLY ISLANDS

Niva Pou Island, 1930, Lt. H. C. Kellers, M. C., seven males, one female (U. S. Nat. Mus.).

AUSTRALIA

N. Queensland, Barren River nr. Barren Waters, IX-28-38, R. G. Wind, nine males, ten females (F. H. Snow Coll.).

Darwin, one male, one female (F. H. Snow Coll.).

Moore Id., Feb. 20, 1945, B. Malkin, eight males, nineteen females (U. S. Nat. Mus.).

Townesville, Jan. 9, 1945, B. Malkin, two males, two females (U. S. Nat. Mus.).

GUAM

Guam, J. B. Thompson, one male (F. H. Snow Coll.).

Anisops cavifrons n. sp.

(Pl. L, fig. 73)

Size.—Males, length 5.1 mm.-5.7 mm., greatest body width 1.3 mm.-1.6 mm.; females length 5.4 mm.-6.0 mm., greatest body width 1.5 mm.-1.8 mm.

Shape.—Fusiform species, greatest body width about midway the body length.

Color.—General facies pearlaceous, hemelytra hyaline and ap-

pearing gray as it overlies the dark dorsal body surface. Legs testaceous. Abdominal venter dark brown with keel and segmental margins of the connexivum testaceous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with vertex projecting beyond the anterior margins of the eyes; greatest width of the head eight to nine tenths the pronotal humeral width and slightly more than four times the anterior width of the vertex; synthlipsis narrow, one fourth to one fifth the anterior width of the vertex; along median longitudinal axis head approximately three fifths as long as pronotum. Pronotum with humeral width slightly less than twice its median length; lateral margins diverging and more than one half the median length; posterior margin convex, medianly emarginate. Frons triangularly excavate; apex rounded; bordered on each side by two carinae, the inner meet in the apical sixth of the frons to form a median commissure. Labrum short; basal width one and three fourths the median length; apex broad and rounded. Rostral prong (Pl. L, fig. 73b) as long as the third rostral segment; apex accuminate. Stridulatory comb (Pl. L, fig. 73c) of approximately fourteen teeth which decrease in height from base to apex. Basal third of posterior margin of fore tibia with a large procumbent spine which curves medianly on dorsal suface. Tarsal claws of male middle leg curved strongly inward at base; posterior claw thicker than anterior one. Chaetotaxy of the front leg as shown on Plate L. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	107	71	..
Middle leg	100	82	36	32
Hind leg	100	74	30	30

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width nine tenths the pronotal humeral width, four to five times the anterior width of vertex; synthlipsis wide, slightly more than one third the anterior width of the vertex; along median longitudinal axis head more than one half the pronotal length. Pronotum with humeral width twice the median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	125	51	31
Middle leg	100	82	41	27
Hind leg	100	80	33	30

Location of types.—Male holotype, female allotype, twenty- three male and eighty-six female paratypes, Lahori, India, Temple tank, I-8-19, in the Indian Museum at Calcutta. Other paratypes are as follows: In the Indian Museum: two males, ten females, Salt Range, Punjab, India, Sta. 13, VII-29, S. L. Hora; one male, Puenjukara Isl. Cochin backwater nr. Ernakulane, F. H. Gravely; three males, four females, Kandaghat, Simla Hills, VIII-25, B. Chopra; six males, seven females, Marihan, Village Tank, XII-30-12, Resee; three males, nine females, Bannu; seven males, six females, Madhupur, Bengal, X-16-09, C. Paiva; one male, two females, Ratnagiri Dist. Chiplum, Vashishti V. O″-300″, V-3 to 5-12, F. H. Gravely. In the Snow Entomological Collection twenty-five males, twenty-five females, Lahori, Temple tank, I-8-19. In Lutz collection: two males and two females, Cantonment Dehra Dun, U. P. India, V-10-1946, Jai L. Uniyal.

Comparative notes.—This species is very closely related to *Anisops batillifrons* Lundblad and appears identical to it in almost every superficial detail. However, the basal third of the posterior margin of the male fore tibia of *A. batillifrons* lacks the large procumbent spine as found on *A. cavifrons*. For comparison of the chaetotaxies of the front legs of the males see Plate L, fig. 73a and Plate L, fig. 71a.

Data on distribution:

INDIA

Simla Hills, Ghuma (Ponds), 3700′, IX-6 to 8-1925, B. Chopra, four males, sixteen females (F. H. Snow Coll.).

Kandaghat, Simla Hills, ponds, 3500′ to 4600′, Sta. 2, VIII-25, B. Chopra, one male, seven females (F. H. Snow Coll.).

Br. India, Coimbatore, L. V. Newton, S. J., nine males, nineteen females (Bueno Coll. of F. H. Snow Coll.).

Br. India, Pulney, L. V. Newton, S. J., one male (Bueno Coll. of F. H. Snow Coll.).

Inde, Darjeeling, le Moult, one male (Bueno Coll. of F. H. Snow Coll.).

Anisops batillifrons Lundblad

(Pl. L, fig. 71; Pl. LVI, fig. 101)

1933. *Anisops batillifrons* Lundblad, Ann. Mag. Nat. Hist., vol. XII, ser. 10, pp. 463-464, text fig. 8.

1935. *Anisops batillifrons*, Wu, Catalogus Insectorum Sinensium, vol. 2, p. 576.

1941. *Anisops batillifrons*, Hoffmann, Lingnan Sci. Jour., vol. 20, p. 59 (catalogue).

Size.—Males, length 5.6 mm.-6.4 mm., greatest body width 1.5 mm.-1.6 mm.; females, length 5.4 mm.-6.3 mm., greatest body width 1.3 mm.-1.8 mm.

Shape.—Fusiform species; greatest body width about two fifths the body length.

Color.—General facies pale, stramineous or gray. Eyes brown. Hemelytra hyaline and appearing stramineous or gray depending on the color of the underlying body surface. Legs stramineous. Abdominal venter dark brown or black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the lateral outline of the head is rounded with the vertex extending beyond the anterior margins of the eyes to form a short cephalic horn; greatest width of the head nine tenths the pronotal humeral width and slightly less than four times the anterior width of the vertex; synthlipsis narrow, less than one fourth the anterior width of the vertex; along the median longitudinal axis the head is approximately three fifths as long as the pronotum. Pronotum with its humeral width slightly less than twice its median length; lateral margins diverging and more than one half the median length; posterior margin convex, medianly emarginate. Frons triangularly excavate; apex rounded; bordered on each side by two carinae, the inner two meet in the apical sixth of the frons to form a median commissure. Labrum short; basal width one and three fourths the median length; apex broad and rounded. Rostral prong (Pl. LVI, fig. 101) slightly longer than the third rostral segment; apex accuminate. Stridulatory comb (Pl. L, fig. 71b) of approximately thirteen teeth, the basal six much longer than the apical seven. Middle tarsal claws strongly curved inward at base, the posterior claw much thicker than the anterior one. Chaetotaxy of the male front leg as shown on Plate L. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	114	68	..
Middle leg	100	81	39	20
Hind leg	100	82	35	36

Female structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width of the head nine tenths the pronotal humeral width and four to five times the anterior width of the vertex; synthlipsis wide, slightly less than one third the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the pronotal length. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and slightly more than

one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	123	54	34
Middle leg	100	90	45	30
Hind leg	100	76	34	32

Location of types.—Type material from Foochow, China in the Stockholm Museum.

Comparative notes.—This species is very closely related to *Anisops bouvieri* Kirkaldy and the females of the two are indistinguishable. However, a study of the males will afford ready separation. The cephalic horn of *Anisops bouvieri* is accuminate at the apex and extends one fifth its ventral length beyond the anterior margins of the eyes, whereas in this species the apex of the cephalic horn is rounded at the apex and extends only one twelfth its ventral length beyond the anterior margins of the eyes. Also the males of *A. batillifrons* lack the three tufts of labral hairs as found on *A. bouvieri.*

Data on distribution:

FORMOSA

Rokki, VI-17-34, L. Gressitt, one male, one female (F. H. Snow Coll.).

Rokki, V-20-34, L. Gressitt, ten males, ten females (F. H. Snow Coll.).

Taihoku, IX-9-22, R. Takahashi, nine females (Bueno Coll. of F. H. Snow Coll.).

Formosa, three males, ten females (Bueno Coll. of F. H. Snow Coll.).

Heito, V-11-34, L. Gressitt, one male, two females (F. H. Snow Coll.).

Yantempo, V-26-07, two females (F. H. Snow Coll.).

IRIOMOTE ISLAND

Iriomote Isd., VIII-25-34, L. Gressitt, one female (F. H. Snow Coll.).

HAINAN ISLAND

Fan Ta, VI-4-35, L. Gressitt (F. H. Snow Coll.).

BURMA

Myitkyina, III-31-45, L. C. Kuitert, two males, eight females (F. H. Snow Coll.).

Myitkyina, XII-18-44, L. C. Kuitert, one female (F. H. Snow Coll.).

Myitkyina, IX-30-45, B. McDermott, one male (F. H. Snow Coll.).

Shingbwiyang, VIII-14-44, L. C. Kuitert, ten males, twenty-three females (F. H. Snow Coll.).

Shingbwiyang, VIII-17-44, L. C. Kuitert, one male (F. H. Snow Coll.).

Rangoon, Churchill Rd. Miss Northop, one male (U. S. Nat. Mus.).

ASSAM

Ledo, VII-3-44, L. C. Kuitert, six males, four females (F. H. Snow Coll.).

Tinsukia, IV-9-44, D. E. Hardy, ten males, twelve females (F. H. Snow Coll.).

Margaldal, Mozbat, I-4-11, S. W. Kemp, four males, nine females (F. H. Snow Coll.).

INDIA

Darjeeling Dist. Sitong Ridge, 4700′, E. Himalayas, three males, six females, N. A. and F. G. (Indian Museum).

Darjeeling Dist. Mongpoo pond, 4000′, E. Himalayas, two males, three females, N. A. and F. G. (Indian Museum).

PHILIPPINE ISLANDS

Bacoor, P. L. Stang, one female (F. H. Snow Coll.).

Mindanao, Dapitan, Baker, three males, nine females (U. S. Nat. Mus.).

Laguna de Bay, VIII-19-1936, two males (Usinger Coll.).

OKINAWA ISLAND

Okinawa Id., Aug. 18, 1945, W. D. Fields (U. S. Nat. Mus.).

Anisops sardea Herrich-Shaffer

(Pl. XLIX, fig. 64; Pl. LVI, fig. 102)

1850. *Anisops sardeus* Herrich-Shaffer, Die Wanzenartigen Insecten, vol. IX, p. 41, fig. 294.

*1870. *Anisops sardeus*, Palumbo, Mina, Bibl. Natur. Sicil. Ent., vol. VII, p. 16.

1879. *Anisops sardeus*, Berg, Hemiptera Argentina, p. 119 (*A sardeus* appears identical with *A. productus* Fieb. to him).

1904. *Anisops sardea*, Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 114-116, 132.

1906. *Anisops sardeus*, Distant, Fauna of British India, Rhynchota, vol. III; pp. 40-41, text fig. 27 (ecological note).

1918. *Anisops sardeus*, Paiva, Rec. Indian Mus., vol. XIV, p. 28 (ecological note).

1925. *Anisops sardea*, Hesse, Ann. South African Mus., vol. XXIII, p. 137 (catalogue).

1926. *Anisops sardea*, Jaczewski, Ann. Zool. Mus. Polonici Hist. Nat., vol. V, p. 83, 83-86, text figs. 34, 35, 36, 37.

1927. *Anisops sardeus*, Dover, Jour. Bombay Nat. Hist. Soc., vol. XXXII, p. 615 (ecological note).

1928. *Anisops sardea*, Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. I, p. 164 (ecological note).

1929. *Anisops sardeus*, Poisson, Bull. Soc. Hist. Nat. Afrique du Nord, vol. XX, p. 87 (ecological note).

1929. *Anisops sardea*, Hutchinson, Ann. South African Mus., vol. XXV, pt. 3, pp. 381-384, Pl. XXIX, fig. 13; Pl. XXX, figs. 7, 8, 9.

1930. *Anisops sardea*, Hutchinson, Proc. Zool. Soc. London, vol. XXIX, pt. 2, p. 445 (ecological note).

1930. *Anisops sardea*, Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. VI, p. 57 (ecological note).

1933. *Anisops sardea*, Hutchinson, Internat. ges. Hydrob. und Hydrog., vol. 28, pt. 5/6, pp. 452, 460 (ecological notes).

1933. *Anisops sardea*, Jaczewski, Linnean Soc. Jour., Zool., vol. XXXVIII, p. 343 (ecological note).

1934. *Anisops sardea*, Jaczewski, Ann. Mus. Zool. Polonici, vol. X, no. 14, p. 280 (ecological note).

1934. *Anisops sardea*, Poisson, Memoires Soc. Hist. Nat. Afrique du Nord, vol. XXV, p. 134 (ecological note).

1935. *Anisops sardea sardea*, Poisson, Mus. Nat. Hist. Nat., vol. III, pp. 208-209, text figs. 22B, 23A, 24B.

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* Reference not seen by me.

1935. *Anisops sardea madagascarensis*, Poisson, (*loc. cit.*) pp. 2091210, text figs. 22A, 23B, 24B. (I have raised this to specific level.)

1936. *Anisops sardea*, Jaczewski, Ann. Mus. Zool. Polonici, vol. XI, pp. 186-187 (ecological note).

1939. *Anisops sardea sardea*, Poisson, Bull. Soc. Ent. France, vol. 44, p. 43 (ecological note).

1941. *Anisops sardea sardea*, Poisson, Rev. Francaise Ent., vol. VIII, p. 77 (ecological note).

Referring to this species also:†

1840. *Anisops nivea*, Spinola, Essais sur Hemipteres, p. 60 (determined in error).

1840. *Anisops nivea*, Rambur, Faune Entomologique de l'Andalouise, vol. 2, no. 5, pp. 190-191 (determined in error).

1843. *Anisops nivea*, Amyot and Serville, Hemipteres, p. 454, Pl. VIII, fig. 8 (determined in error).

1848. *Anisops nivea*, Costa, Atti Reale Inst. Incorag. Alle Sci. Nat. Napoli, vol. III, p. 148 (determined in error).

1848. *Anisops nivea*, Amyot, Entomologie Francaise, Rhynchota, p. 338 (determined in error).

1855. *Anisops natalensis*, Stål, Ofversift Kongl. Vetensk. Akad. Forhand., vol. XII, p. 89 (determined in error).

1851. *Anisops productus*, Fieber, Abhandl. Bohm. Ges. Wiss., vol. V, pt. 7, p. 484.

1860. *Anisops productus*, Fieber, Die Europaische Hemiptera, p. 100.

1862. *Anisops productus*, Schawn, Peter's Reise nach Mossambique, V. p. 51.

1865. *Anisops productus*, Stål, Hemiptera Africana III, p. 191.

*1872. *Anisops productus*, Marshall, Ent. Month. Mag., vol. VIII, p. 191.

1873. *Anisops producta*, Gerstaecker, Decken Reise's in Ost Africa III, no. 2, p. 425.

1878. *Anisops producta*, Horvath, Entomologische Nachrichten, vol. IV, p. 174.

*1880. *Anisops producta*, Puton, Synopsis des Heteropteres de France, p. 217.

1886. *Anisops producta*, Puton, Exploration Scientifique de la Tunisie, p. 8 (ecological note).

1892. *Anisops producta*, De Carlini, Ann. Mus. Civ. Storia Nat. Genova, vol. XII (XXXII), p. 11 (ecological note).

1893. *Anisops producta*, Noualhier, Ann. Soc. Ent. France, vol. LXII, p. 17 (ecological note).

1899. *Anisops producta*, Kirkaldy, Ann. Soc. Ent. France, vol. LXVIII, p. 106 (ecological note).

1883. *Anisops producta*, Lethierry, Ann. Mus. Civ. Storia Nat. Genova, vol. XVIII, p. 2 (ecological note).

1892. *Anisops producta*, Liethierry, Bull. Soc. Ent. France, vol. XVII, p. 208 (ecological note).

*1894. *Anisops producta*, Giglia-Tos, Boll. Mus. Zool. Anat. Comp., vol. IX, p. 11.

1905. *Anisops producta*, Breddin, Mitt. Naturh. Mus., vol. XXII, pp. 153-154.

1919. *Anisops producta*, Hungerford, Kansas Sci. Bull., vol. XXI, p. 176.

1922. *Anisops producta*, Lindberg, Notulae Entomologicae, vol. II, pp. 47-48, text figs. 5, 6.

1926. *Anisops producta*, Poisson, Acad. Sci. Paris, vol. 181, p. 684.

1926. *Anisops producta*, Poisson, Arch. Zool. Exper. Gen., vol. 65, pt. 4, pp. 181-208, text figs. I-XVII (bionomics).

1926. *Anisops producta*, Poisson, Bull. Soc. Hist. Nat. Afrique du Nord, vol. XXII, p. 269 (ecological note).

1936. *Anisops producta*, Lindberg, Soc. Scient. Fennica Comment. Biol., vol. VI, no. 7, pp. 41-42 (ecological note).

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* Reference not seen by me.

† The following reference as noted by Kirkaldy in 1904 (30) was unavailable: *? N. alba* Forskal, Decr. Anim. Orient, p. XXIII. The name *A. compressa* as noted by Herrich-Shaffer and Kirkaldy (30) evidently is a manuscript name, for there is no reference to it in the literature.

Size.—Males, length 7.5 mm.-8.4 mm., greatest body width 1.8 mm.-1.9 mm.; females, length 7.2 mm.-7.5 mm., greatest body width 1.9 mm.-2.0 mm.

Shape.—Subfusiform species; greatest body width about midway the length of the body.

Color.—General facies stramineous or testaceous. Eyes brown. Hemelytra may be hyaline and appear darker due to dark brown body surface. Legs stramineous. Abdominal venter dark brown or black with keel and segmental margins of the connexivum stramineous or testaceous.

Male structural characteristics.—Viewed from above, the interocular space is produced anteriorly into a prominent cephalic horn with its apex accuminate; lateral margins of the head rounded; greatest width of the head nine tenths the pronotal humeral width and three times the anterior width of the vertex; synthlipsis narrow, approximately one sixth the anterior width of the vertex; along the median longitudinal axis the head is slightly more than three fourths the length of the pronotum. Pronotum with its humeral width almost twice the median length; lateral margins diverging and almost one half the median length; posterior margin convex, medianly emarginate. Frons, which forms the ventral margin of the cephalic horn, excavate for its entire length and bordered laterally by two carinae; apex more or less accuminate. Labrum short; basal width slightly more than twice the median length; apex accuminate; each basal angle bearing a tuft of erect hairs whose tips are curved medianly and meet one another, forming a loop. Rostral prong (Pl. LVI, fig. 102) slightly shorter than the third rostral segment; apex accuminate. Stridulatory comb (Pl. XLIX, fig. 64b) of approximately eighteen teeth which decrease slightly in length from base to apex. Middle tarsal claws strongly curved inward at base; posterior claw thicker than anterior claw. The chaetotaxy of the front leg as shown on Plate XLIX. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	118	72	..
Middle leg	100	83	42	20
Hind leg	100	84	30	30

Female structural characteristics.—Viewed from above, the outline of the head is rounded, with the vertex extending slightly beyond the anterior margins of the eyes; greatest width of head nine

tenths the pronotal humeral width and approximately four times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head almost as long as the pronotum. Pronotum with its humeral width twice the median length; posterior margin convex, medianly emarginate. Facial tubercle with a slight triangular depression. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	118	55	33
Middle leg	100	86	42	23
Hind leg	100	80	31	30

Location of types.—The location of the type material of *A. sardea* appears to be unknown. As it was part of Herrich-Shaffer's own collection it may be in the Berlin Museum, though Dr. H. B. Hungerford does not record it in the notonectid material he observed there in 1928.

Comparative notes.—Though somewhat larger, this species, by the presence and shape of the male cephalic projection is very similar in appearance to *A. bouvieri* Kirk. Besides being larger it is different in many other respects from Kirkaldy's species. It lacks the laterally expanded keel of the third abdominal sternite as possessed by *A. bouvieri*. *A. bouvieri* does not have the marginal row of prominent setae on the inner surface of the fore tibia of the male of *A. sardea*.

Data on distribution:

INDIA

Baluchistan, Yakmach Cagai, XI-13-18, B. S., one male (F. H. Snow Coll.).

Punjab, Salt Pangi, Sta. 9. S. L. Hora, two males, two females (F. H. Snow Coll.), seven males, three females (Indian Museum).

Moriban, Village tank, XII-20-15, Resee, four females (Indian Museum).

S. India. Chikkaballpura, T. V. Campbell, two females (F. H. Snow Coll.).

Kuman Lakes, one female (Indian Museum).

Bannu, one female (Indian Museum).

Lucknow, I-22-08, Mus. Collr. R. H., one male, four females (Indian Museum).

S. India, Coromandel, 2500' X-23-10, Mus. Collr., one male (Indian Museum).

TURKEY

Erdemli, VIII-27-47, two males, two females (F. H. Snow Coll.).

SYRIA

Syria, Kaifa, Reuter, exchange fr. Budapest Museum, two females (F. H. Snow Coll.).

Corfu

Corfu, J. Sahlberg, gift fr. Horvath, Kirkaldy remnant, one male, one female (F. H. Snow Coll.).

Albania

Mustajebg Velipoja, one male (F. H. Snow Coll.).

Africa

Egypt, Dr. Tuton, one male (U. S. Nat. Mus.).

Egypt, Mariout, 1881, Letournex, two males, two females (Paris Museum).

Egypt, R. Amle, 1881, Letournex, three females (Paris Museum).

Basse Egypte, Le Caire et Env. 1907, Ch. Alluaud, one male, three females (Paris Museum).

Soudan Egyptian, Poseires, Haut Nil Bleu, Dec. 1907, Ch. Alluaud, one male, one female (Paris Museum).

Soudan, Nioro, Oct. 1909, F. de Zeltner, one male (Paris Museum).

Algerie, Bone, Hgemn, one female (F. H. Snow Coll.).

Algerie, Philippville, A. Thery, three females, one male (Bueno Coll. of F. H. Snow Coll.).

Abessynien, one female (Bueno Coll. of F. H. Snow Coll.).

Abessynien, Dire Doana, two females (Bueno Coll. of F. H. Snow Coll.).

Cairo, four females (Bueno Coll. of F. H. Snow Coll.).

Algerie, Constantine, E. de. Bergevin, one female (Paris Museum).

Morco, Si Rahal, 1913, R. Pallary, one male, one female (Paris Museum).

Moroc, Oued, Mharhar pris Bow Berein, 1903, C. Buchet, three males, three females (Paris Museum).

Moroc, Andiere, Boegel Merare, 1903, C. Buchet, one female (Paris Museum).

Tchad, N'Guigmi, 1919, Dr. Noel, one female, one male (Paris Museum).

Tchad, Mission Tihlo, 1910, Dr. Gaillard, two females (Paris Museum).

Bas Chari, Fort Lamt, Mission Chari-Tchad, Aug. 1904, Dr. J. DeCorse, three males, six females (Paris Museum).

Reg. de Zinder, Dungass, Mission Tilho, Oct. 1910, Dr. R. Guillard, five males, seven females (Paris Museum), one male, one female, Jan. 1910 (Paris Museum).

Sahel Soudanais, Goumbou, 1909, F. de Zeltner, one male, three females (Paris Museum).

Env. de Zinder, Guidimouni, Mission Tilho, Nov. 1910, Ch. Alluaud, one male, one female (Paris Museum).

Mocambique, Vallee du Pungoue, Guengere, 1906, G. Vassee, one male, three females (Paris Museum).

Kanem, Sud de Nyouri, 1904, A. Chevalier, two males (Paris Museum).

Congo Francaise, Liberville, 1898, C. Chalot, one male (Paris Museum).

Haut Oubangui, Bessou (Mission), 1904, Dr. J. DeCorse, one female (Paris Museum).

Massahori, 66 K. est du Tchad, 1904, A. Chevalier, one female (Paris Museum).

Afrique Orient. Angl. Maji-Chumi, (Wa-Nyika) 1904, Ch. Alluaud, one female (Paris Museum).

Tombouctore, 1900, A. Chevalier, one male, two females (Paris Museum).

Abyssinia, Hora Abjata, small pond in marsh, XI-18-1926, J. Omer-Cooper, one female (F. H. Snow Coll.).

E. Africa, P. H. Uhler Collection (U. S. Nat. Mus.).

Tanga, Sjostedt, gift from Sweeny (Kirkaldy remnant) (F. H. Snow Coll.).

Transvaal, Klobers Dam, Setagali Dist., Mafering, Jan. 1927.

B. Lamb, gift to H. B. Hungerford fr. G. E. Hutchinson, one male, one female (F. H. Snow Coll.).

Kilimandjoro, Sjostedt, Natron-sjoarne, gift fr. Sweeny, one female (F. H. Snow Coll.).

French Sudan, Bamako, purchased fr. Dr. O. Standlinger, one male, five females (F. H. Snow Coll.).

Oran, E. Morrison, one male, three females (F. H. Snow Coll.).

CANARY ISLANDS

Ile de Canaries, 1897, C. Buchet, two males, two females (Paris Museum).

Islas Canarias, Tenerife, A. Cabrera, one male, six females (Bueno Coll. of F. H. Snow Coll.).

Tenerife, two females (Bueno Coll. of F. H. Snow Coll.).

Anisops madagascarensis Poisson

(Pl. XLIX, fig. 67)

1935. *Anisops sardea madagascarensis* Poisson, Bull. Mus. Nat. Hist. Natur., vol. III, pp. 208-211, text figs. 22A, 23A, 24B.

Size.—Males, length 8.1 mm.-9.0 mm., greatest body width 1.9 mm.-2.1 mm.; females, length 7.3 mm.-7.8 mm., greatest body width 1.9 mm.-2.1 mm.

Shape.—Subfusiform species; greatest width of the body slightly before midway the body length.

Color.—General facies testaceous. Eyes brown. Hemelytra may be hyaline and appear darker due to dark brown body surface. Legs stramineous. Abdominal venter dark brown, with keel and segmental margins of the connexivum stramineous. Tip of cephalic horn black.

Male structural characteristics.—Viewed from above, the interocular space is produced anteriorly into a prominent cephalic horn with its apex accuminate; lateral margins of the head rounded; greatest width of the head eight tenths the pronotal humeral width and three times the anterior width of the vertex; synthlipsis narrow, one sixth the anterior width of the vertex; along the median longitudinal axis the head is three fourths the length of the pronotum. Pronotum with its humeral width one and two thirds the median length; lateral margins diverging and three fifths the median length; posterior margin convex, medianly emarginate. Frons, which forms

the ventral margin of the cephalic horn, excavate for its entire length and bordered laterally by two carinae; apex more or less accuminate. Labrum short; basal width slightly more than twice the median length; apex accuminate; each basal angle bearing a tuft of erect hairs which curve their tips medianly and meet one another forming a loop. Rostral prong as in *A. sardea* (Pl. LVI, fig. 102) longer than third rostral segment; apex accuminate. Stridulatory comb (Pl. XLIX, fig. 67b) of approximately seventeen teeth, which decrease slightly in length from base to apex. Middle tarsal claws strongly curved inward at the base, posterior claw thicker than anterior one. Chaetotaxy of male front leg as shown on Plate XLIX. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	119	64	..
Middle leg	100	88	42	19
Hind leg	100	83	33	33

Female structural characteristics.—Viewed from above, the outline of the head is rounded, with the vertex extending slightly beyond the anterior margins of the eyes; greatest width of the head nine tenths of the pronotal humeral width and almost four times the anterior width of the vertex; synthlipsis narrow, slightly more than one fourth the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the length of the pronotum. Pronotum with its humeral width twice its median length; lateral margins diverging and almost one half the median length; posterior margin convex, medianly emarginate. Facial tubercle with a faint triangular depression. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	118	54	29
Middle leg	100	81	41	21
Hind leg	100	82	34	32

Location of types.—Type material from Madagascar in the Paris Museum.

Comparative notes.—This species is almost identical with *A. sardea* H.-S. from which it can be best separated on the basis of the chaetotaxy of the male front leg. The setae of the fore tibia in this species are never spatulate whereas the second and third basal setae of *Anisops sardea* are spatulate. The tip of the cephalic horn in all the specimens that I have observed is black, a condition pointed out by Poisson (*loc. cit.*). This peculiarity is not encountered in *A. sardea*.

Remarks.—This species was first described as a sub-species by Poisson (*loc. cit.*). However, I am placing it on specific level on the basis of the above differences between it and *A. sardea* H.-S.

Data on distribution:

MADAGASCAR

Tananarive, 1921, R. Decary, five males, nineteen females (Paris Museum); two males, two females (F. H. Snow Museum).

Marais du Finerena, 1905, F. Geay, two males, eight females (Paris Museum).

Madagascar, 1897, E. Dorr, two females (Paris Museum).

Madagascar, 1897, F. de Zeltner, one female (Paris Museum).

Plaines du Sakondry, 1906, F. Geay, one female (Paris Museum).

Madagascar, P. Camboue, two females (Paris Museum).

Tananarive, purchased fr. Prof. Lamberton Nov. 1931, one male, one female (F. H. Snow Coll.).

Maroantsetra, purchased fr. Dr. O. Standinger, one female (F. H. Snow Coll.).

Mocquereya, Chutes de Samilia, Riv. N. Gamie, G. Severin, one male (U. S. Nat. Mus.).

Madagascar, one male, two females (Bueno Coll. of F. H. Snow Coll.).

Anisops bouvieri Kirkaldy

(Pl. XLIX, fig. 65; Pl. LV, fig. 100)

1904. *Anisops bouvieri Kirkaldy*, Wiener Ent. Zeit., vol. XXIII, pp. 116, 132.

1933. *Anisops bouvieri*, Hoffmann, Lingnan Sci. Jour., vol. 12, p. 256 (catalogue).

1933. *Anisops bouvieri*, Lundblad, Arch. für Hydrob., Suppl. vol. XII, p. 145 (a list of Indo-australian and Pacific members of this genus).

1935. *Anisops bouvieri*, Wu, Catalogus Insectorum Sinensium, vol. II, p. 575.

1941. *Anisops bouvieri*, Hoffmann, Lingnan Sci. Jour., vol. 20, p. 59 (catalogue).

Size.—Males, length 6.0 mm.-6.3 mm., greatest body width 1.5 mm.-1.8 mm.; females, length 5.7 mm.-6.0 mm., greatest body width 1.7 mm.-1.8 mm.

Shape.—Fusiform species; greatest body width about two fifths the body length.

Color.—General facies pearlaceous. Eyes gray. Abdominal venter dark brown with keel and segmental margins of the connexivum pearlaceous.

Male structural characteristics.—Viewed from above, the lateral outline of the head is rounded; vertex extended anteriorly into a short cephalic horn; greatest width of the head nine tenths the pronotal humeral width and slightly more than three times the anterior width of the vertex; synthlipsis narrow, almost one fourth the anterior width of the vertex; along the median longitudinal axis the head minus the cephalic horn is two thirds the length of the pronotum. Pronotum with its humeral width one and four fifth times

the median length; lateral margins diverging and two thirds the median length; posterior margin convex, medianly emarginate. Viewed ventrally the frons which forms the ventral margin of the cephalic horn is triangularly excavate; bordered laterally by two carinae; apex more or less accuminate. Labrum short and broad; basal width slightly more than one and one half its median length; apex accuminate; bears three tufts of hairs, one at each basal angle and one at the apex. Rostral prong (Pl. LV, fig. 100), as long as the third rostral segment; apex accuminate. Stridulatory comb (Pl. XLIX, fig. 65b) of approximately twelve teeth which decrease in length from base to apex. Middle tarsal claws strongly curved inward at base, posterior claw thicker than anterior one. The keel of the third abdominal segment is flattened and bordered on its lateral and apical margins by stout erect hairs. Chaetotaxy of the male front leg as shown on Plate XLIX. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	102	75	..
Middle leg	100	74	38	33
Hind leg	100	78	32	28

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal humeral width and slightly more than three times the anterior width of the vertex; synthlipsis wide, almost one half the anterior width of the vertex; along the median longitudinal axis the head is two thirds as long as the pronotum; lateral margins diverging and almost three fifths the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	114	57	29
Middle leg	100	90	45	22
Hind leg	100	84	32	28

Location of types.—Male type from Cochin China, in the Paris Museum.

Comparative notes.—This species is closely related to *Anisops batillifrons* Lundblad, however the cephalic horn is more or less accuminate and extends one fifth its ventral length beyond the anterior margin of the eyes, whereas in *A. batillifrons* the cephalic horn is rounded at the apex and extends only one twelfth its ventral length beyond the anterior margin of the eyes. In addition,

A. batillifrons lacks the tufts of labral hairs that are found on this species.

Data on distribution:

NEW GUINEA

Simbang Huon Gulf, 1898, Biro, one male, twenty-four females (F. H. Snow Coll.).

SIAM

Brangkok, Sept. 17, 1926, H. M. Smith (U. S. Nat. Mus.).

BURMA

Mohnyin, X-27-44, L. C. Kiuitert, two males, three females (F. H. Snow Coll.).

ASSAM

Tinsukia, IV-9-44, D. E. Hardy, one male (F. H. Snow Coll.).

INDIA

Barkuda, Chilka Lake, Ganjam Dist. Madras Pres. VIII-19, F. H. Gravely, twenty-five males, twenty-five females (F. H. Snow Coll.); thirty males, thirty-six females (Indian Museum).

Barkuda, Chilka Lake, Ganjam Dist. Madras Pres. VII-23-19, N. A. one male, twenty-two females (Indian Museum).

Waltair, I-27-21, fourteen males, nine females (Indian Museum).

Calcutta, Eden Gardens at light, X-26-11, F. H. Gravely, one male, two females (Indian Museum).

Calcutta, Eden Gardens at light, X-11, F. H. Gravely, one female (Indian Museum).

Calcutta, VIII-9-'06, two males (Indian Museum).

Bengal, Berhampore, Court, IV-13-10 S. W. K., one male (Indian Museum).

Bengal, Madhupur, X-16-09, C. Paiva, two males, seven females (Indian Museum).

Bengal, Berhampur Murshidabad, Sept. '12, Southwell, one male, five females (Indian Museum).

East Bengal, Damukdia Ghat, VII-22-17, Mus. Collr. four males, two females (Indian Museum).

Central Province, Purhapura, III-4-19, C. P. and F. H. G., twelve males, seven females (Indian Museum).

Puri Dist. Barkul, Orissa, XI-9th to 13th-12, Gravely, six males, twenty-one females (Indian Museum).

Madras, Ganjam Dist, Rambha, IX-20-13,, Annandale, seventeen males, five females (Bueno Coll. of F. H. Snow Coll.).

Andamans, fresh water tank, III-31-11, C. Paiva, three males, one female (Bueno Coll. of F. H. Snow Coll.).

Orissa, Lake Chilka, Satpara, IX-10-13, Annandale, seventeen males, two females (Bueno Coll. of F. H. Snow Coll.).

Anisops extendofrons n. sp.

(Pl. XLIX, fig. 66)

Size.—Males, length 6.4 mm.-6.8 mm., greatest body width 1.5 mm.-1.7 mm.; females, length 6 mm., greatest body width 1.8 mm.

Shape.—Subfusiform species; lateral margins in anterior half of

body, with exception of the head, almost parallel; posterior lateral margins converging.

Color.—General facies pearlaceous. Eyes brown. Legs testaceous. Abdominal venter dark brown or black, with keel and segmental margins of the connexivum testaceous.

Male structural characteristics.—Viewed from above, the lateral outline of the head is rounded with the anterior interocular space extended forward in a cephalic horn; greatest width of the head nine tenths the pronotal humeral width, slightly more than three times the anterior width of the vertex; synthlipsis narrow, less than one third the anterior width of the vertex; along the median longitudinal axis the head is approximately three fourths the pronotal length. Pronotum with its humeral width almost twice its median length; lateral margins diverging and slightly more than two thirds the median length; posterior margin convex, medianly concave. Viewed ventrally the frons, which forms the ventral surface of the cephalic horn, is triangularly excavate, bordered laterally by two carinae; apex more or less accuminate. Viewed laterally the cephalic horn extends one third its ventral length beyond the anterior margin of the eyes. Labrum short; basal width almost twice its median length; apex accuminate; bears three tufts of anteriorly curved hairs, one at each basal angle and one at the apex. Rostral prong slightly shorter than third rostral segment; apex accuminate. Fore tibia (Pl. XLIX, fig. 66b) with anterior margin curved at apex; stridulatory comb of approximately fourteen teeth which decrease in height from base to apex. Middle tarsal claws turned strongly inward at base; posterior claw thicker than anterior claw. Chaetotaxy of the male front leg as shown on Plate XLIX. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	123	96	..
Middle leg	100	92	46	23
Hind leg	100	78	30	29

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest head width nine tenths the pronotal humeral width, slightly less than four times the anterior width of the vertex; synthlipsis wide, almost one half the anterior width of the vertex; along the median longitudinal axis the head is one half the pronotal length. Pronotum with humeral width twice its median length; lateral margins diverging and three fifths the

median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	114	60	29
Middle leg	100	80	40	22
Hind leg	100	78	35	33

Location of types.—Male holotype, female allotype, five male and three female paratypes, Waltair, India, I-27-21 in the Indian Museum at Calcutta. Other paratypes are as follows: In the Indian Museum at Calcutta: one male, Puenjikara Isl. Cochin Backwater nr. Ernakulane, India, X-14, F. H. Gravely; one male, one female, Satara Dist. 2000′, Nechal, W. Chata, F. H. Gravely. In the Snow Entomological Collection: five males, three females, Waltair, India, I-27-21.

Comparative notes.—Extremely closely related to *Anisops bouvieri* Kirk. and superficially the two species appear the same. However, careful examination of the males will show distinct differences. The anterior margin of the fore tibiae lack the subapical angle as found on *A. bouvieri* and also the long spine borne at the angle. The keel of the third abdominal segment of *A. extendofrons* is not flattened and bordered with hairs as in *A. bouvieri,* but covered with hairs.

Data on distribution:

INDIA

Br. India, Coimbatore, L. V. Newton S. J., one male (Bueno Coll. of F. H. Snow Coll.).

Anisops graciloides n. sp.

(Pl. LI, fig. 79)

Size.—Males, length 7.0 mm.-8.2 mm., greatest body width 1.5 mm.-2.1 mm.; females, length 7.5 mm., greatest body width 1.9 mm.

Shape.—Slender, fusiform species; greatest width about midway the body length.

Color.—General facies testaceous. Eyes brown or gray. Legs stramineous. Abdominal venter irregularly colored dark brown and gray.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal humeral width and six and one-half times the anterior width of the vertex; synthlipsis narrow; one fifth the anterior width of the vertex; along the median longitudinal axis the head is slightly more than two thirds the length of the pronotum. Pronotum with

its humeral width almost twice its median length; lateral margins only slightly diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly compressed laterally with a slight median depression. Labrum long, basal width slightly less than its median length; apex rounded. Rostral prong (Pl. LI, fig. 79b) shorter than third rostral segment; apex rounded. Stridulatory ridge (Pl. LI, fig. 79a) transversely striated. Stridulatory comb (Pl. LI, fig. 79c) of approximately sixteen teeth which increase slightly in length from base to apex. Chaetotaxy of front leg as shown on Plate LI. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	112	56	..
Middle leg	100	95	41	28
Hind leg	100	92	34	34

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the humeral width and almost four times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is almost two thirds the length of the pronotum. Pronotum with its humeral width twice the median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	113	50	38
Middle leg	100	89	42	27
Hind leg	100	83	34	34

Location of types.—Male holotype and female allotype, Salisbury, S. Rhodesia, X-16-15, in the Snow Entomological Collection. Two male paratypes Africa nr. Kabale, Uganda, L. Bungymi, Feb. 1948, R. X. Williams in the Harvard Museum of Comparative Zoology.

Comparative notes.—This species is closely related to *Anisops gracilis* Hutchinson from which it can be separated by the fact that the males have the facial tubercle slightly compressed laterally and bearing a faint median depression. This condition is lacking on the males of *A. gracilis.* Also the rostral prong has a rounded apex instead of the accuminate apex of *A. gracillis.*

Data on distribution.—Known only from type series.

Anisops gracilis Hutchinson*

(Pl. LI, fig. 74)

1929. *Anisops gracilis* Hutchinson, Ann. South African Mus., vol. XXV, pt. 3, pp. 386-388, Pl. XXX, fig. 12; Pl. XXXI, fig. 4; Pl. XXXII, fig. 12.

Size.—Males, length 6.9 mm., greatest body width 1.8 mm.

Shape.—Slender, fusiform species; greatest width about halfway the body length.

Color.—General facies stramineous. Eyes brown. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal humeral width and five and one-half times the anterior width of the vertex; synthlipsis narrow, one fourth the anterior width of the vertex; along the median longitudinal axis the head is three fourths the length of the pronotum. Pronotum with its humeral width slightly less than twice the median length; lateral margins slightly diverging and one half the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised. Labrum long, median length equal to the basal width; apex rounded. Rostral prong (Pl. LI. fig. 74b) longer than third rostral segment; apex accuminate. Stridulatory ridge (Pl. LI. fig. 74c) with transverse striations; stridulatory comb of approximately fourteen even-length teeth. Chaetotaxy of the male front leg as shown on Plate LI. The relative lengths of the parts of the legs are as follows:†

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	113	62	..
Hind leg	100	83	31	33

Location of types.—Type material from South Africa in the South African Museum.

Comparative notes.—The body shape and coloration are similar to that of *A. balcis* Hutchinson from which it can be separated by the fact that the males of *A. gracilis* lack the flattened facial tubercle so characteristic of *A. balcis*. The latter species does not have a striated stridulatory ridge as found on the former species.

Data on distribution:

AFRICA

South Africa, Messina, Limpopo gorge, V-27-1921, gift to H. B. H. fr. G. W. Hutchinson, one male (F. H. Snow Coll.).

* Only a single male specimen of this species was in my material.

† Minus the middle pair of legs.

Anisops poweri Hutchinson*

(Pl. L, fig. 72; Pl. LIV, fig. 95)

1929. *Anisops poweri* Hutchinson, Ann. South African Mus., vol. XXV, pt. 3, pp. 398-390, Pl. XXX, fig. 13; Pl. XXXI, fig. 6, 6a.

1933. *Anisops poweri,* Hutchinson, Internat. ges. Hydrob. und Hydrog., vol. 28, pt. 5/6, p. 460 (ecological note).

Size.—Males, length 5.7 mm., greatest body width 1.5 mm.

Shape.—Small, fusiform species; greatest body width about midway the body length.

Color.—General body color stramineous. Eyes brown. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head is eight tenths the pronotal humeral width and slightly more than three times the anterior width of the vertex; synthlipsis narrow, slightly more than one fourth the anterior width of the vertex; length of the median longitudinal axis the head is slightly more than one half the length of the pronotum. Pronotum with its humeral width almost twice the median length; lateral margins diverging and two thirds the median length; posterior margin convex, medianly emarginate. Facial tubercle greatly swollen. Labrum with its basal width one and one half the median length; apex rounded. Rostral prong (Pl. LIV, fig. 95) slightly shorter than the third rostral segment. Stridulatory comb broken off of the legs of the specimen in my material. Chaetotxy of the male front leg as shown on plate L. The relative length of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	105	56	..
Middle leg	100	87	41	26
Hind leg	100	81	32	36

Location of types.—Type material from Kimberly Cape, South Africa in the South African Museum.

Comparative notes.—The long claws of the male front leg are found on only one other species, *A. leesoniana* Hutch. from which it may be readily distinguished on the basis of the male facial tubercle and the fore tarsus. The facial tubercle of *A. poweri* is greatly swollen and the basal inner surface of the fore tarsus bears a median row of three long spines. Neither of these conditions is found on *A. leesoniana.*

* Only a male specimen was present in my material.

Data on distribution:

AFRICA

Orange River, Diep Klof, east of Aliwil N., IX-5-28, gift to H. B. H. fr. G. E. Hutchinson, one male (F. H. Snow Coll.).

Anisops leesoniana Hutchinson*

(Pl. L, fig. 70)

1929. *Anisops leesoniana* Hutchinson, Ann. South African Mus., vol. XXV, pt. 3, pp. 390-391, Pl. XXX, fig. 14; Pl. XXXI, fig. 7.

Size.—Males, length 4.8 mm.; greatest body width 1.3 mm.

Shape.—Small, fusiform species; greatest body width midway the body length.

Color.—General facies stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width of the head almost equal to the pronotal humeral width and seven times the anterior width of the vertex; synthlipsis narrow, one sixth the anterior width of the vertex; along the median longitudinal axis the head is three fourths the length of the pronotum. Pronotum with its humeral width almost twice its median length; lateral margins almost parallel and one half the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised. Labrum with lateral margins strongly converging; basal width equal to the median length; apex more or less accuminate. Rostral prong (Pl. XV, fig. 70b) slightly shorter than third rostral segment; apex accuminate. Stridulatory comb (Pl. L, fig. 70c) of approximately twenty-three teeth, with the apical one slightly shorter than the remainder. Chaetotaxy of the male front leg as shown on Plate L. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	105	70	..
Middle leg	100	86	41	25
Hind leg	100	87	31	31

Location of types.—Male holotype from South Rhodesia in the South African Museum.

Comparative notes.—This species and *A. poweri* Hutchinson are unique in having the extremely long front tarsal claws, more than one half the length of the fore tarsi. *Anisops leesoniana* differs in many respects from *A. poweri* however; the facial tubercle is not

* Only a single male specimen in my material and it is badly mutilated.

greatly swollen as in *A. poweri,* and the fore tarsal claws are not curved as in the case of the latter.

Data on distribution:

AFRICA

South Africa, Rikatle, Lourenco Marques. Coll. Junod., one male (Basel Nat. Hist. Mus., Switzerland).

Anisops breddeni Kirkaldy

(Pl. LI, fig. 78; Pl. LV, fig. 99)

1901. *Anisops breddeni* Kirkaldy, The Entomologist, vol. 34, pp. 5-6.

1901. *Anisops breddeni,* Breddin, Abhand. Naturf. Gesell. Halle, vol. XXIV, p. 103 (ecological note).

1904. *Anisops breddeni,* Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 117, 132.

1910. *Anisops breddeni,* Distant, Fauna of British India, Rhynchota, vol. V, p. 333, fig. 194 (ecological note; expresses doubt as to its belonging in this genus).

1928. *Anisops breddeni,* Dover, Treubia, vol. X, p. 171 (ecological note, disagrees with Distant and beheves it should remain in the genus).

1933. *Anisops breddeni,* Lundblad, Archiv. für Hydrob. Suppl. vol. XII, p. 145 (a list of Indo-australian and Pacific members of this genus).

Size.—Males, length 5.7 mm.-6.6 mm., greatest body width 1.2 mm.-1.6 mm.; females, length 5.4 mm.-5.7 mm., greatest body width 1.2 mm.-1.5 mm.

Shape.—Slender, slightly fusiform species; greatest width about one half the body length.

Color.—General facies pearlaceous. Eyes brown. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is more or less conical with the anterior margin of the vertex extending slightly beyond that of the eyes; greatest width of the head almost equal to the pronotal humeral width and five to six times the anterior width of the vertex; eyes holoptic for the basal three eighths of the median length of the head; along the median longitudinal axis the head is slightly more than one half the length of the pronotum. Pronotum with its humeral width almost twice its median length; lateral margins parallel and two thirds the median length; posterior margin convex, medianly emarginate. Scutellum greatly reduced, basal width only slightly more than median length. Facial tubercle swollen. Labrum strongly convex transversely; basal width equal to its median length; apex rounded. Rostral prong (Pl. LV, fig. 99) accuminate. Rostrum with the second rostral segment produced into a flaplike process that extends behind the third and fourth segments, not adjacent to the fourth and the apical half of the third segments. Fore leg (Pl. LI, fig. 78a) with femur greatly expanded dorso-ventrally, with dorsal margin convex; stridulatory comb (Pl. LI, fig. 78b) highly

irregular, apical fourth and fifth teeth flattened and capitate. Chaetotaxy of the male front leg as shown on Plate LI. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	114	71	..
Middle leg	100	85	40	33
Hind leg	100	77	31	28

Female structural characteristics.—Viewed from above, the outline of the head is rounded with the vertex extending slightly beyond the anterior margin of the eyes, greatest width of head nine tenths the pronotal humeral width and slightly more than five times the anterior width of the vertex; eyes holoptic for the basal third of the median length of the head; along the median longitudinal axis the head is three fourths the length of the pronotum. Pronotum with humeral width slightly more than twice the median length; lateral margins slightly diverging and almost as long as the median length of the pronotum; posterior margin convex, medianly emarginate. Second rostral segment produced into a short spur on its apical posterior margin. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	57	36
Middle leg	100	86	40	27
Hind leg	100	81	34	34

Location of types.—The type material from Celebes in the Breddin Collection of the Hamburg Museum. One female co-type, Celebes, Lura See bei Lura, VIII-95, Dr. Sarasin, in the Kirkaldy Collection of the Snow Entomological Collection.

Comparative notes.—Very closely related to *Anisops kempi* n. sp. from which it can best be separated on the basis of the males. The males of *A. breddeni* Kirkaldy have the lateral margins of the pronotum almost parallel while in the former species they are distinctly diverging. Also the scutellum is much smaller in the case of *A. breddeni*, with its basal width only slightly more than its median length whereas in *A. kempi* the basal width of the pronotum is one and one third the median length. The outline of the head of *A. breddeni* is more or less conical whereas that of *A. kempi* is rounded.

Data on distribution:

INDIA

Puenjikara Island, Cochin Backwater, nr. Ernakulane, X-14, F. H. Gravely, one male (F. H. Snow Coll.); one male (Indian Museum).

Barkuda, Chilka Lake, Ganjam Dist. Madras Pres. VIII-19, F. H. Gravely (F. H. Snow Coll.)

Calcutta, Lakes, Sta. 4, three females (Indian Museum).

BURMA

Rangoon, VIII-21-15, Hodgard, three males (Indian Museum); one female (F. H. Snow Coll.)

CEYLON

Mt. Lavinia, Mar. 9, '96, Madarasz, one male, one female (F. H. Snow Coll.)

Anisops kempi n. sp.

(Pl. LI, fig. 75)

Size.—Males, length, 5.7 mm.-6.6 mm., greatest body width 1.3 mm.-1.6 mm.; females, length 5.4 mm.-6.0 mm., greatest body width 1.4 mm.-1.6 mm.

Shape.—Slender, slightly fusiform species, with greatest width about midway its length.

Color.—General facies stramineous. Eyes brown. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest head width nine tenths the pronotal humeral width and five to seven times the anterior width of the vertex; eyes holoptic in basal third of head; along median longitudinal axis head approximately two thirds the pronotal length. Pronotum with its humeral width about one and one half its median length; lateral margins diverging and two thirds median length; posterior margin convex, medianly emarginate. Scutellum with basal width one and one third its median length. Facial tubercle slightly raised. Labrum short; basal width only slightly more than median length; apex rounded. Rostral prong (Pl. LI, fig. 75b) accuminate at apex. Second rostral segment extended into flaplike process behind third and fourth rostral segments, not adjacent to the fourth or apical half of the third rostral segments. Fore leg (Pl. LI, fig. 75a) with femur greatly expanded dorsoventrally; stridulatory comb highly irregular, with four prominent teeth, the middle two flattened and capitate (Pl. LI, fig. 75c). Chaetotaxy as shown on Plate LI. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	125	69	..
Middle leg	100	82	41	23
Hind leg	100	82	32	26

Female structural characteristics.—Viewed from above the outline of the head is rounded; greatest head width nine tenths pronotal length, five times the anterior width of the vertex; eyes holoptic in basal third of the head; along the median longitudinal axis the head is approximately two thirds the pronotal length. Pronotum with humeral width slightly more than twice its median length; lateral margins diverging and almost one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	133	50	33
Middle leg	100	86	38	25
Hind leg	100	86	34	30

Location of types.—Male holotype, female allotype, Assam, Tinsukia IV-9-44, D. E. Hardy in the Snow Entomological Collection. The paratypes are as follows: In the Snow Entomological Collection: four males, two females, Drappa nr. Calcutta, India, I-22-11, Kemp. In the Indian Museum at Calcutta: One male, Calcutta, at light, VI-7-11, F. H. G.; one male, four females, Calcutta, XII-2-07; two males, one female, Calcutta, Eden gardens, at light, X-14-11, F. H. Gravely; one female, Garia nr. Calcutta, XII-13-10; one female, Lower Burma, Amherst Dist., Kawkareih to third Camp, XI-21-11 to XII-1-11, F. H. Gravely. In the United States National Museum: one male, Siam, Bangkok, Sept. 17, 1926, H. N. Smith.

Comparative notes.—This species appears very similar to *Anisops breddeni* Kirkaldy. However, the pronotal lateral margins of *A. kempi* diverge whereas in *A. breddeni* they are almost parallel. Also the head of the latter is more or less conical with the vertex extending beyond the anterior margins of the eyes, while in *A. kempi* the outline of the head is rounded. Also the latter species has a much larger scutellum which has a basal width one and one third its median length, whereas in *A. breddeni* the scutellum is small with its basal width only slightly more than its median length.

Data on distribution:

INDIA

Orissa, Satpara, IX-10-13, N. A., one male (F. H. Snow Coll.) United Prov. Cannapore Dist. X-1 to 8-1911, J. W. C., two males, four females (F. H. Snow Coll.).

Anisops crinita n. sp.

(Pl. L, fig. 68)

Size.—Males, length 4.9 mm.-5.4 mm., greatest body width 1.3 mm.-1.5 mm; females, length 4.8 mm.-5.7 mm., greatest body width 1.3 mm.-1.6 mm.

Shape.—Small, fusiform species; greatest body width about midway the body length.

Color.—General facies stramineous or testaceous. Eyes brown or gray. Hemelytra may have hyaline areas which appear darker due to the underlying dark brown dorsal body surface. Legs stramineous. Abdominal venter dark brown or black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width nine tenths the pronotal humeral width, five times the anterior width of the vertex; synthlipsis narrow, between one sixth and one seventh the anterior width of the vertex; along the median longitudinal axis the head is slightly more than three fifths the pronotal length. Pronotum with its humeral width approximately twice the median length; lateral margins diverging and at least one half the median length; posterior margin almost straight, with only slight median emargination. Frons slightly depressed, with facial tubercle flat and covered with small procumbent hairs. Labrum short, covered with long hairs; basal width one and one half its median length; apex broad and rounded, almost truncate. Rostral prong (Pl. L, fig. 68c) shorter than third rostral segment; apex truncate. Stridulatory comb (Pl. L, fig. 68b) of approximately six to nine even-length teeth. Chaetotaxy of the male front leg as shown on Plate L. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	125	75	..
Middle leg	100	80	40	23
Hind leg	100	79	30	30

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width nine tenths the pronotal humeral width; four to six times the anterior width of the vertex; synthlipsis variable, from one fifth to one sixth the anterior width of the vertex; along the median longitudinal axis the head is three fifths the pronotal length. Pronotum with humeral width slightly more than twice its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly

emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	125	47	29
Middle leg	100	81	38	20
Hind leg	100	80	28	30

Location of types.—Male holotype, female allotype, one male and one female paratypes, Corfu, J. Sahlb. in the Kirkaldy Collection of the Snow Entomological Collection. Other paratypes are as follows: In the Snow Entomological Collection: twelve males, five females, Daulatabad, Seistan Village, pond, XII-20-18, Sta. 29, B. S.; one male, New Caledonia, Noumea, A. Faval. In the Indian Museum at Calcutta: thirteen males, five females, Daulatabad, Seistan Village, pond, XII-20-18, Sta. 29, B. S.; three males, five females, Baluchistan, Zangi Nawar, 20 mi. w. of Nushki, XII-25 to 29-18, Sta. 35, B. S., N. A. & S. K.; two males, three females, Ganjam Dist. Barkuda, Chilka Lake, Madras Pres. VIII-18, F. H. Gravely; one male, Baluchistan, Quetta, 5700″, pond in res. garden, Sta. 3, XI-10, BS: one male, one female, Berhampur, Murshidabad, Bengal, Sept. '12, Southwell.

Comparative notes.—About the same size and general appearance as *A. nivea* (Fabricius). However, the males of *A. crinita* lack the excavate facial tubercle and peculiarly twisted tarsal claws as found on the males of *A. nivea.* Also the labral hairs of *A. crinita* are not organized into definite tufts as those of *A. nivea.*

Data on distribution.—Known only from type series.

Anisops majiensis n. sp.

(P. LII, fig. 83)

Size.—Males, length 6 mm., greatest body width 1.5 mm.; females, length 6.3 mm., greatest body width 1.6 mm.

Shape.—Fusiform species; greatest width about midway the body length.

Color.—General facies stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width slightly less than the pronotal humeral width and five times the anterior width of the vertex; synthlipsis extremely narrow, one tenth the anterior width of the vertex; along the median longitudinal axis the head is eight tenths the pronotal length. Pronotum with its humeral width

twice the median length; lateral margins diverging and slightly more than three fifths the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised. Labrum short and broad; basal width twice the median length; apex more or less accuminate. Rostral prong (Pl. LII, fig. 83b) longer than the third rostral segment; apex accuminate. Fore leg (Pl. LII, fig. 83a) with anterior femur enlarged at apex and rounded; stridulatory comb (Pl. LII, fig. 83c) of approximately twenty-four teeth, with basal fifteen almost twice the length of the apical nine. Chaetotaxy of the male front leg as shown on Plate LII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	110	55	..
Middle leg	100	82	36	23
Hind leg	100	82	32	32

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head only slightly less than the pronotal humeral width and five to six times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is almost as long as the pronotum. Pronotum with its humeral width one and one half the median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	121	71	54
Middle leg	100	91	46	27
Hind leg	100	81	33	33

Location of types.—Male holotype, female allotype, Afrique, Orient, Angl. Maji-Chumvi, (Wa-Nyika) 1904, Ch. Alluaud, in the Paris Museum.

Comparative notes.—The chaetotaxy of the male front legs is strongly suggestive of a relationship with *A. debilis* Gerst. However, the latter species does not have the extremely narrow (one tenth the anterior width of the vertex) synthlipsis, nor the apically enlarged and rounded front femur as found on the males of this species.

Data on distribution.—Known only from type series.

Anisops debilis Gerstaecker

(Pl. LII, fig. 80)

1873. *Anisops debilis* Gerstaecker, Decken's Reise in Ost Africa III, pt. 2, p. 425.
1904. *Anisops debilis*, Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 119, 132.
1926. *Anisops debilis*, Jaczewski, Annal. Zool. Musei Polonici Hist. Nat. vol. V., no. 2, pp. 86-88, text fig. 38, 39, 40, 41.
1929. *Anisops debilis*. Hutchinson, Ann. South African Mus., vol. XXV, pt. 3, pp. 391-392, Pl. XXX, fig. 15.
1930. *Anisops debilis*, Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. VI, p. 58 (ecological note).
1933. *Anisops debilis*, Hutchinson, Inter. ges. Hydrob. Hydrog., vol. 28, p. 45, pt. 5/6, p. 461.
1935. *Anisops debilis*, Poisson, Mus. Nat. Hist. Nat., vol. III, pp. 211-213, text figs. 26, 27.
1937. *Anisops debilis*, Poisson, Ann. Soc. Ent. France, vol. CVI, pp. 117-118, text fig. 3.
1939. *Anisops debilis*, Poisson, Bull. Soc. Ent. France, vol. 44, p. 43 (ecological note).

Size.—Males, length 5.8 mm.-6.3 mm., greatest body width 1.5 mm.-1.7 mm.; females, length 6.3 mm., greatest body width 1.5 mm.

Shape.—Slender, fusiform species; greatest body width about midway the body length.

Color.—General facies gray. Eyes brown. Eyes and pronotum testaceous. Scutellum testaceous with two triangular hyaline areas on each side of the anterior half. Hemelytra hyaline and appear dark gray due to the underlying black dorsal body surface. Legs stramineous. Abdominal venter dark brown or black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the pronotal humeral width and six times the anterior width of the vertex; synthlipsis narrow, between one fourth and one fifth the anterior width of the vertex; along median longitudinal axis the head is more than one half the length of the pronotum. Pronotum with its humeral width twice the median length; lateral margins diverging and three fifths the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised. Labrum with its basal width one and one third the median length; apex rounded. Rostral prong (Pl. LII, fig. 80b) longer than the third rostral segment; apex accuminate. Stridulatory comb (Pl. LII, fig. 80c) of approximately twenty-one teeth which decrease slightly in length from base to apex. The chaetotaxy of the male front leg as shown on Plate LII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	114	71	..
Middle leg	100	86	43	35
Hind leg	100	80	31	31

Female structural characteristics.—Viewed from above the outline of the head is rounded; greatest width of the head nine tenths the pronotal humeral width and five times the anterior width of the vertex; synthlipsis narrow, less than one third the anterior width of the vertex; along the median longitudinal axis the head is slightly more than one half the length of the pronotum. Pronotum with its humeral width twice the median length; lateral margins diverging and almost one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	115	54	31
Middle leg	100	82	41	32
Hind leg	100	80	30	30

Location of types.—Type material from East Africa in the Berlin Museum.

Comparative notes.—The narrow synthlipsis and shape of the rostral prong make this species similar to *A. vitrea* Signoret. However, this species is a larger one than *A. vitrea* and the males lack the flattened facial tubercle as found on the *A. vitrea.*

Data on distribution:

AFRICA

French Sudan, Bamako, March 1929, A. Bang Baas, purchased fr. Dr. O. Standinger, two males, five females (F. H. Snow Coll.).

Uganda, Katona, IX-1913, Muyenju, exchange fr. Horvath, one male, one female (F. H. Snow Coll.).

Messina, Limpopo, V-25-'92, gift to H. B. H. fr. G. E. Hutchinson, two females (F. H. Snow Coll.).

Ogaden, Quabi-Chebeli, Imi Mission, 1902, Du Bourg de Bozas, two males, one female (F. H. Snow Coll.); six females, one male (Paris Museum) Soudan, Mioro, Oct. 1909, E. De Zeltner, five males, one female (Paris Museum).

Env. de Zinder, Guidimauni (mission Tilho) 1910, Dr. R. Gaillard three males (Paris Museum).

Central Afr. Uganda, Entebbe, H. Rolle, one male, three females (Bueno Coll. of F. H. Snow Coll.).

Anisops exigera Horvath

(Pl. LI, fig. 77)

1919. *Anisops exigera* Horvath, Abhand. Senckenberg. naturf. Gesell., vol. XXXV, p. 314.
1933. *Anisops exigera*, Lundblad, Arch. für Hydrob. Suppl., vol. XII, p. 145 (a list of Indo-australian and Pacific forms of this genus).

Size.—Males, length 4.3 mm.-4.5 mm., greatest body width 1.2 mm.; females, length 4.3 mm.-4.5 mm., greatest body width 1.2 mm.

Shape.—Small, subfusiform species with lateral margins in an-

terior half of body almost parallel, lateral margins of posterior half converging.

Color.—General facies pearlaceous. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width of the head eight tenths the pronotal humeral width and six times the anterior width of the vertex; synthlipsis narrow, from one fifth to one sixth the anterior width of the vertex; along the median longitudinal axis the head is almost as long as the pronotum. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and one half as long as the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised, Labrum with its basal width one and one fourth times its median length; apex truncate, with its length almost one half the basal width. Rostral prong (Pl. LI, fig. 77b) shorter than the third rostral segment; apex rounded. Stridulatory comb (Pl. LI, fig. 77c) of approximately ten distinct teeth which increase in length toward the middle. Chaetotaxy of the front leg as shown on Plate LI. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	114	77	..
Middle leg	100	78	33	22
Hind leg	100	78	30	30

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head nine tenths the pronotal humeral width and six times the anterior width of the vertex; synthlipsis narrow, one fifth the anterior width of the vertex; along the median longitudinal axis the head is two thirds the length of the pronotum. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and slightly more than one-half the median length; posterior margin convex, slightly convex medianly. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	124	44	32
Middle leg	100	77	35	22
Hind leg	100	77	31	31

Location of types.—Type material from New Guinea, Simbang Huon Gulf, 1898, Biro, in the Budapest Museum in Hungary.

Comparative notes.—This species is about the same size and general facies as *Anisops nivea* Fabr. from which it can be readily separated at once on the basis of the males which lack the excavate frons as found on the males of *A. nivea.* Both sexes of *A. exigera* possess a much narrower synthlipsis, only one fifth to one sixth the anterior width of the vertex, where as the synthlipsis of *A. nivea* is much wider, being approximately one third the anterior width of the vertex.

Data on distribution:

New Guinea

Simbang Huon Golf, 1898, Biro (determined by Horvath), one male (F. H. Snow Coll.).

India

Puenyikara Isl., Cochin Backwater nr. Ernakulane, X-14, F. H. Gravely, nine males, fourteen females (F. H. Snow Coll.).

Central Province, Varcam Tank nr. Pachmachi, Satpura Hills, 3000′, Sta. 16, C. P. and F. H. G., thirteen males, nine females (Indian Museum).

Morihan, XI-20-15, Rescee, five females (Indian Museum).

Anisops vitrea Signoret

(Pl. LI, fig. 76)

1860. *Anisops vitrea* Signoret, Ann. Soc. Ent. France, vol. VIII, no. 3, p. 792.

1895. *Anisops vitrea,* De Carlini, Ann. Mus. Civ. Stor. Nat. Genova, Series 2a, vol. XV (XXXV), p. 19 (ecological note).

1899. *Anisops vitrea,* Kirkaldy, Ann. Soc. Ent. France, vol. LXVIII, pp. 160-107 (=*persephone* Kirkaldy).

1904. *Anisops vitrea,* Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 119, 132.

1926. *Anisops vitrea,* Horvath, Arch. für Zool., vol. 18A, no. 31, p. 2 (determined in error; actually *A. jaczewski* Hutchinson).

1926. *Anisops vitrea,* Jaczewski, Ann. Zool. Musei Polonici Hist. Nat., vol. V, p. 86 text figs. 42, 43, 44 (determined in error; actually *A. jaczewski* Hutchinson)

1928. *Anisops vitrea,* Hutchinson, Ann. Mag. Nat. Hist., Ser. 10, vol. I, pp. 303-304, text figs. 1, a, b (cites the error of Horvath and Jaczewski and names the species observed by them *A. jaczewski*).

Referring to this species also

1898. *Anisops persephone* Kirkaldy, Wiener Ent. Zeit., vol. XVIII, p. 142.

1913. *Anisops aldabrana,* Distant, Trans. Linn. Soc. London, vol. 16, p. 189, Pl. XIII, fig. 30.

1927. *Anisops aldabrana,* Hutchinson, Ann. Mag. Nat. Hist., Ser. 9, vol. 19, p. 376, text figs. 1, a b.

Size.—Males, length 4.5 mm.-5.1 mm., greatest body width 1.2 mm.-1.3 mm.; females, length 4.5 mm.-5.1 mm., greatest body width 1.2 mm.-1.3 mm.

Shape.—Small, subfusiform species; greatest body width about one third the length of the body.

Color.—General facies dark gray. Eyes brown. Vertex and pronotum stramineous, the latter may have a median longitudinal band

of orange. Scutellum testaceous or orange with anterior margin dark brown. Hemelytra hyaline and appear dark gray due to the dark color of the underlying body surface. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width of the head eight tenths the pronotol humeral width and six to seven times the anterior width of the vertex; synthlipsis narrow, from one sixth to one eighth the anterior width of the vertex; along the median longitudinal axis the head is almost as long as the pronotum. Pronotum with its humeral width slightly more than twice the median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised and flattened on ventral surface; flattened area surrounded by more or less triangular, faint ridge. Labrum short and with a few procumbent hairs; basal width almost twice the median length. Rostral prong (Pl. LI, fig. 76b) longer than the third rostral segment; apex accuminate. Stridulatory comb (Pl. LI, fig. 76c) of approximately twenty teeth, teeth slightly shorter at apex than at base. Chaetotaxy of the male front leg as shown on Plate LI. The relative lengths of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	80	..
Middle leg	100	85	41	27
Hind leg	100	75	33	33

Female structural characteristics.—Viewed from above the outline of the head is rounded; greatest width of the head almost nine tenths the pronotal humeral width and seven times the anterior width of the vertex; synthlipsis narrow, about one fourth the anterior width of the vertex; along the median longitudinal axis the head is two thirds the length of the pronotum. Pronotum with its humeral width slightly more than twice the median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	120	54	32
Middle leg	100	85	41	27
Hind leg	100	76	33	33

Location of types.—Type material in Stockholm Museum.

Comparative notes.—Though not quite as robust as *Anisops edepol* Kirk., this species is of approximately the same length. However, the two are by no means similar. They can be readily distinguished by the fact that the latter species has the posterior margin of the pronotum almost straight instead of convex and medianly emarginate as in the case of *A. vitrea.* Also the males of *A. vitrea* lack the short spur on the facial tubercle as found on the males of *A. edepoi.*

Remarks.—I was fortunate in having at my disposal some of the specimens of *Anisops aldabrana* Distant collected by J. F. Fryer at the same time as the type. Though a trifle smaller than *A. vitrea,* this species is identical in every other respect and therefore is being placed as a synonym of *A. vitrea.*

Data on distribution:

Madagascar

Tananarive, purchased from Prof. C. Lamberton, thirty-six males, thirty-four females (F. H. Snow Coll.).

Moroantsetra, March, 1929, A. Bang Baas, purchased from Dr. O. Standlinger, nineteen males, twenty-nine females (F. H. Snow Coll.).

Madagascar, 1897, F. de Zeltner, one female (Paris Museum).

Reg. du Sud-est, Vallee du Fanjahira Isaka, 1901, Ch. Alluaud, one male (Paris Museum).

Boeni, Maevatanano, Oct.-Nov. 1899, Dr. J. DeCorse, two females (Paris Museum).

Madagascar, two males, (Bueno Coll. of F. H. Snow Coll.).

Madagascar, 1897, E. Dorr, four females (Paris Museum).

Prov. D'Ankavandra, I-98, S. Hure, one male, one female (Paris Museum).

Marais du Finerena, 1905, G. Geay, three males, three females (Paris Museum).

Antanimora, 1901, Ch. Alluaud, two males, four females (Paris Museum).

Annanariva, Sikora, 1896, Noualhier, three males, one female (Paris Museum).

Diego-Suarez, five males (U. S. Nat. Mus.).

Diego-Suarez, 1893, Ch. Alluaud, five males, eleven females (U. S. Nat. Mus.); one female (Paris Museum).

Aldabra Island

Aldabra, IX-'08, J. C. F. Fryer, one male, three females (F. H. Snow Coll.).

Mauritius

Roduit, III-25-1948, R. Manet, three males, one female (F. H. Snow Coll.).

La Reunion

Plides Palmistes, 1897, Ch. Alluaud, one male, (Bueno Coll. of F. H. Snow Coll.).

Anisops hypatia Hutchinson

(Pl. LII, fig. 82)

1929. *Anisops hypatia* Hutchinson, Ann. South African Mus. vol. XXV, pt. 3, pp. 399-400, Pl. XXX, fig. 16; Pl. XXXII, figs. 2, 2a.

Size.—Males, length 5.4 mm., greatest body width 1.5 mm.; females, length 5.7 mm., greatest body width 1.7 mm.

Shape.—Small, fusiform species; greatest body width midway the body length.

Color.—General facies stramineous. Eyes brown. Abdominal venter dark brown with keel and segmental margins stramineous.

Male structural characteristics.—Viewed from above the outline of the head is rounded with the anterior margin almost straight; greatest width of the head equal to the pronotal humeral width and five times the anterior width of the vertex; synthlipsis narrow, slightly more than one fourth the anterior width of the vertex; along the median longitudinal axis the head is slightly shorter than the length of the pronotum. Pronotum with its humeral width twice its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. Facial tubercle raised. Labrum with basal width almost one and one-half the median length; apex rounded. Rostral prong (Pl. LII, fig. 82b) as long as the third rostral segment; apex accuminate. Stridulatory comb (Pl. LII, fig. 82c) of approximately fourteen teeth which increase in length from base to apex. Chaetotaxy of the male front leg as shown on Plate LII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	124	92	..
Middle leg	100	80	39	24
Hind leg	100	81	36	38

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head slightly less than the pronotal humeral width and five times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is almost equal to the length of the pronotum. Pronotum with its humeral width twice its median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	118	55	35
Middle leg	100	94	42	32
Hind leg	100	85	33	34

Location of types.—Type material from Cape Province, Africa in the South African Museum.

Comparative notes.—This species is of the same general appearance as *A. amaryllis* Hutchinson, however the head of the males is much wider, being equal to the pronotal humeral width instead of only nine tenths the pronotal humeral width as in *A. amaryllis*. Also the latter species lacks the short basal row of three small spines as found on the inner surface of the fore tarsi of *A. hypatia*.

Data on distribution:

Africa

Concordia, pond nr. Knysna, XII-23-1926, Gift to H. B. H. fr. G. E. Hutchinson, one male, one female (F. H. Snow Coll.).

Anisops balcis Hutchinson

(Pl. LII, fig. 84; Pl. LV, fig. 97)

1930. *Anisops balcis* Hutchinson, Proc. Zool. Soc. London, vol. XXIX, prt. 2, pp. 447-448, text fig. 4, a, b, c.

1930. *Anisops balcis*, Hutchinson, Ann. Mag. Nat. Hist. vol. VI, Series 10, p. 59 (ecological note).

1932. *Anisops balcis*, Hutchinson, Ann. Mag. Nat. Hist. vol. IX, Ser. 10, p. 324 (ecological note).

1933. *Anisops balcis*, Hutchinson, Internat. ges. Hydrob. und Hydrog., vol. 28, prt 5/6, p. 462 (ecological note).

1933. *Anisops balcis*, Jaczwski, Linn. Society Jour. Zool., vol. XXXVIII, p. 345 (ecological note).

Size.—Males, length 6.8 mm., greatest body width 1.8 mm.; females, length 6.6 mm., greatest body width 1.8 mm.

Shape.—Slender and slightly fusiform species; greatest body width slightly before midway the body length.

Color.—General facies testaceous. Abdominal venter dark brown with keel and segmental margins of the connexivum testaceous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of the head eight tenths the pronotal humeral width and seven times the anterior width of the vertex; synthlipsis narrow, one fourth the anterior width of the vertex; along the median longitudinal axis the head is three fourths the length of the pronotum. Pronotum with its humeral width almost twice the median length; lateral margins almost parallel, only slightly diverging and two thirds the median length; posterior margin convex, medianly emarginate. Facial tubercle slightly raised and triangularly flattened. Labrum short and broad; basal width one and one half its median length; apex rounded. Rostral prong (Pl. LV, fig. 97) longer than the third rostral segment; apex acuminate. Anterior femur enlarged dorso-ventrally in apical half; apex truncate. Stridulatory comb (Pl. LII, fig. 84b) of about twenty-two

teeth, increasing in length at the middle. Chaetotaxy of the front leg as shown on Plate LII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	112	75	..
Middle leg	100	85	39	26
Hind leg	100	78	32	32

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head eight tenths the pronotal humeral width and five and one half times the anterior width of the vertex; synthlipsis narrow, slightly more than one fourth the anterior width of the vertex; along the median longitudinal axis the head is almost two thirds the length of the pronotum. Pronotum with its humeral width slightly more than twice the median length; lateral margins diverging and three fifths the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	114	57	33
Middle leg	100	84	32	27
Hind leg	100	78	32	32

Location of types.—Type material from Lake Zwai, c. 5500′, XI-4-1926, J. Omer-Cooper, in the British Museum.

Comparative notes.—This species is similar in body shape to *A. gracilis* Hutchinson from which it can be distinguished by the fact that the males lack the transversely striated ridge as found on the latter species. The males of *A. gracilis* do not possess the flattened facial tubercle found on the males of this species.

Data on distribution:

AFRICA

Uganda, Hippo Pt. Lake Victoria, Feb. 29, 1948, F. X. Williams, two males (Harv. Mus. Comp. Zool.).

Uganda, Lake Baringo, 1931, E. W. Worthington, one male (F. H. Snow Coll.).

Abyssinia, Hora Abjata, small pond in Marsh, XI-18-1926, J. Omer-Cooper, one male, one female, exchange from British Museum (F. H. Snow Coll.).

Anisops biroi n. sp.

(Pl. XLV, fig. 49)

Size.—Males, length 4.2 mm.-4.5 mm., greatest body width 1.2 mm.-1.3 mm.; females, length 4.3 mm., greatest body width 1.2 mm.

Shape.—Small, fusiform species, with greatest width about two fifths the body length.

Color.—General facies stramineous. Eyes brown. Pronotum may be hyaline and appear the brown color of the underlying scutellum. Legs stramineous. Abdominal venter dark brown with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—As viewed from above, the outline of the head is rounded with its greatest width nine tenths the pronotal humeral width and approximately nine times the anterior width of the vertex; synthlipsis narrow, approximately one fifth the anterior width of the vertex; along the median longitudinal axis the length of the head is equal to or slightly less than that of the pronotum. Pronotum with its humeral width at least twice its median length; lateral margins diverging and slightly less than one half the median length; posterior margin convex, medianly emarginate. Facial tubercle simple, neither raised nor excavate Rostral prong (Pl. XLV, fig. 49b) at least as long as third rostral segment; apex accuminate. Labrum short and spinose; basal width slightly more than median length; apex accuminate. Stridulatory comb (Pl. XLV, fig. 49c) of approximately twenty-two teeth. Chaetotaxy of the male front legs as shown on Plate XLV. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	125	81	..
Middle leg	100	83	36	26
Hind leg	100	83	30	33

Female structural characteristics.—As viewed from above, the outline of the head is rounded; greatest width of the head nine tenths the pronotal humeral width and eight times the anterior width of the vertex; synthlipsis wide, one third the anterior width of the vertex; along the median longitudinal axis the head is seven tenths the length of the pronotum. Pronotum with its humeral width two and one half times the median length; lateral margins diverging and one half the median length; posterior margin convex, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg,	2nd Tar. Seg.
Fore leg	100	120	54	34
Middle leg	100	78	34	28
Hind leg	100	83	31	33

Location of types.—Male holotype, female allotype, two male and one female paratypes, New Guinea, Seleo Berlinhafen, '96, Biro in the Kirkaldy Collection of the Snow Entomological Collection.

Comparative notes.—Very similar to *A. rigoensis* n. sp. from which

it differs in having its rostral prongs at least as long as the third rostral segment whereas in *A. rigoensis* the rostral prongs are shorter than the third rostral segment. Also *A. biroi* lacks the short row of three small setae on the inner surface of the male anterior tarsi as found on the males of *A. rigoensis.*

Data on distribution.—Known only from type series.

Anisops rigoensis n. sp.

(Pl. LII, fig. 81)

Size.—Males, length 4.8 mm.-5.1 mm., greatest body width 1.3 mm.; females, length, 5.4 mm.-6.0 mm., greatest body width 1.3 mm.-1.5 mm.

Shape.—Small, fusiform species, with greatest body width about four tenths its body length.

Color.—General facies gray. Eyes gray or dark brown. Vertex, pronotum, and scutellum testaceous. The latter may be black and may have its hemelytral margins tinged with crimson. Hemelytra hyaline and appear dark gray, gray, or testaceous depending on the color of the underlying body surface. Legs stramineous. Abdominal venter black with keel and segmental margins of the connexivum stramineous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded, with its greatest width almost nine tenths the pronotal humeral width and eight to nine times the anterior width of the vertex; synthlipsis variable, from one fifth to one third the anterior width of the vertex; along the median longitudinal axis the head is equal to or longer than twice its median length; lateral margins diverging and slightly more than twice its median length; posterior margin convex, medianly emarginate. Facial tubercle only slightly raised. Labrum with its basal width slightly more than its median length. Rostral prong (Pl. LII, fig. 81b) slightly longer than the third rostral segment; apex accuminate. Stridulatory comb (Pl. LII, fig. 81c) of approximately twenty teeth; basal eight much shorter than others. Chaetotaxy of the front leg as shown on Plate LII. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	126	88	..
Middle leg	100	70	32	22
Hind leg	100	85	31	31

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head nine tenths the

pronotal humeral width and approximately seven times the anterior width of the vertex; synthlipsis narrow, between one fifth and one sixth the anterior width of the vertex; along the median longitudinal axis the head is three fourths the pronotal length. Pronotum with its humeral width slightly more than twice its median length; lateral margins diverging and slightly more than one half the median length; posterior margin concave, medianly emarginate. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	130	64	42
Middle leg	100	85	40	25
Hind leg	100	83	34	36

Location of types.—Male holotype, female allotype, three male and six female paratypes, New Guinea, Rigo, Luglio, 1889, L. Loria in the Snow Entomological Collection. Other paratypes are: one male, three females, New Guinea, Lemian Berlinhafen, '96, Biro and one female New Guinea, Friedrich-Wilh.-hafen, '96, Biro in the Kirkaldy collection of the Snow Entomological Collection.

Comparative notes.—Very similar to *Anisops birio* n. sp. and is separated best from this species on the character of the rostral prong, which in *A. biroi* extends its dorsal margin almost to the apex of the third rostral segment whereas in *A. rigoensis* the dorsal margin of the prong extends scarcely beyond the base. For comparison of the chaetotaxies of the front legs of the males see Pl. LII, fig. 81a and Pl. XLV, fig. 49a.

Data on distribution.—Known only from type series.

Anisops waltairensis n. sp.

(Pl. L, fig. 69)

Size.—Males, length 4.5 mm.-4.7 mm., greatest body width 1.2 mm.-1.4 mm.; females, length 4.8 mm.-5.1 mm., greatest body width 1.5 mm.-1.6 mm.

Shape.—Small, fusiform species; greatest body width about midway the body length.

Color.—General facies pale, may be stramineous or pearlaceous. Legs testaceous. Abdominal venter with keel and segmental margins of the connexivum stramineous or pearlaceous.

Male structural characteristics.—Viewed from above, the outline of the head is rounded with the greatest width almost nine tenths the pronotal humeral width and approximately eight times the anterior width of the vertex; synthlipsis narrow, about one eighth

the anterior width of the vertex; along the median longitudinal axis the head is nine tenths the pronotal length. Pronotum with humeral width two and one half times the median length; lateral margins diverging and slightly more than one half the median length; posterior margin convex, slightly concave medianly. Facial tubercle only slightly raised. Labrum long; median length equal to its basal width. Rostral prong (Pl. L, fig. 69b) slightly shorter than the third rostral segment; apex more or less accuminate. Stridulatory comb (Pl. L, fig. 69c) of approximately eleven teeth which increase in length toward the middle. Chaetotaxy of the male front leg as shown on Plate L. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	118	85	..
Middle leg	100	82	42	24
Hind leg	100	75	33	33

Female structural characteristics.—Viewed from above, the outline of the head is rounded; greatest width of head eight to nine tenths the pronotal humeral width and almost eight times the anterior width of the vertex; synthlipsis narrow, one seventh the anterior width of the vertex; along the median longitudinal axis the head is three fourths the pronotal length. Pronotum with humeral width two and one half times the median length; lateral margins diverging and slightly more than one half the median length; posterior margins convex, medianly concave. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st Tar. Seg.	2nd Tar. Seg.
Fore leg	100	116	57	32
Middle leg	100	80	40	20
Hind leg	100	85	37	30

Location of types.—Male holotype, female allotype, Waltair, India, I-27-21 in the Indian Museum. Paratypes are as follows. In the Indian Museum: two males, Kalka, Base of Simla Hills, 2400″, VII-16-11, Mus. Collr.; one female, Kalka, base of Simla Hills, 2400″, in small pond of rain water, Annandale. In the Snow Entomological Collection: one male, one female, Waltair, India, I-27-21; one male Kalka, Base of Simla Hills, 2400″, VII-16-11, Mus. Collr.; one female Kalka, Base of Simla Hills, 2400″, in small pond of rain water, Annandale.

Comparative notes.—About the same size and general appearance as *A. exigera* Horvath, from which it differs in having a much narrower synthlipsis, one eighth the anterior width of the vertex and

in having its rostral prong accuminate at the apex whereas in *A. exigera* the synthlipsis, though narrow is about one sixth the anterior width of the vertex and the rostral prong is truncate at the apex.

Data on distribution.—Known only from type series.

Anisops ali Distant

1911. *Anisops ali* Distant, The Entomologist, vol. 44, p. 107.
1933. *Anisops ali*, Lundblad, Arch. für Hydrob. Suppl., vol. XII, p. 146 (a list of Indo-australian and Pacific members of this genus).

As no specimens of this species were available for study I have chosen to present a copy of the original description.

"Ochraceous, the hemelytra more or less shaded with fuliginous; eyes black; interocular space narrow, margins parallel, not or very slightly narrowing at base, above with a distinct central longitudinal impression, the margins of which are ridged, beneath narrow, parallel, of the same breadth throughout; pronotum with a distinct waved carinate line on the anterior area, commencing on the lateral margins behind eyes and then roundly directed upward and united between the inner posterior angles of the eyes; abdomen beneath fuscous. This species is allied in general coloration to *A. sardea*, Herr.-Schaff., and *A. fiebri*, Kirk. From both of these, however, it is distinctly separated by the narrow parallel interocular space, and by the distinct carinate waved line to the pronotum. Long. 5 to 6½ millim."

Hab. Ceylon; Diyatalawa (E. E. Green).

Location of types.—Female type located in the British Museum.

Anisops alluaudi Poisson

(Pl. LIII, fig. 85)

1945. *Anisops alluaudi* Poisson, Bull. Soc. Ent. France, vol. 50, pp. 92-93, text fig. 6.

This species was not present in the material at my disposal. Therefore I shall present a translation of the original description and copies of the drawings.

Anisops Alluaudi n. sp.

Vertex two times wider than the synthlipsis; head (eyes included) two times longer than its posterior width. Pronotum 1.8 times wider than long, its posterior margin concave. Scutellum 1.17 times longer than pronotum.

Eyes grayish brown; pronotum and scutellum brownish black, abdominal tergites, anterior and posterior black, the intermediate yellowish, bordered with black; hemelytra hyaline, not trimmed with red.

Male: Third rostral segment presenting the long lateral spurs.

Anterior leg: F-100, T-120, t-91, c-29.

The tibial comb composed of 10-12 spatulate teeth, regularly distributed; the tibia carries on its internal and lower side a short spine, there are three others, linearly distributed on the internal and basal side of the tarsi.

Length 7 mm.

Distribution: two males (1), La Reunion; Plaine des palmistes (Ch. Alluaud).

Location of types.—Type material destroyed during the war.

Anisops aphrodite Kirkaldy

1900. *Anisops aphrodite* Kirkaldy, Ann. Soc. Ent. Belgique, vol. XLIV, p. 435.

1905. *Anisops aphrodite*, Bergroth, and Shouteden. Ann. Soc. Ent. Belgique, vol. XLIX, pp. 388-389 (cites Kirkaldy's omission of this species from his "Uber Notonectiden" in 1904).

Kirkaldy (30) omitted this species from his Uber Notonectiden. Whether or not he considered it as a synonym of a previously described species or whether it was just an oversight on his part has been a question confronting all subsequent workers. The type material from Kinchassa is in the Perth Museum. As yet the species has not been redescribed and as the type material was unavailable to me I can present only a translation of the original description.

Anisops aphrodite.—Vertex approximately four times wider than the synthlipsis. Scutellum $\frac{3}{5}$ longer than the pronotum.

Male. Anterior tibia one-fifth longer than the femur and one fourth longer than the tarsus, the latter approximately three times as long as the claws which are shaped as fingers. Middle femur three eighths longer than the tibia, the latter three-eighths longer than the tarsus, first tarsal segment two-fifths longer than the second, the latter two times as long as the falciform claws.

Female. Anterior tibia one-sixth longer than the tarsus, first tarsal segment one-third longer than the second, the latter one-third longer than the claws. Middle tibia one-fourth longer than the tarsus, first tarsal segment one-third longer than the second, the latter two times as long as the falciform claws.

Male, female length. $5\frac{1}{7}$ mm., width $1\frac{4}{5}$ mm.

Kinchassa (Waelbroeck, Type), Lemba (Gilmont) and Boma (Tschoffen).

Hemelytra hyaline, transparent. Abdomen black above and beneath, genital segments flavus.

Anisops calcaratus Hale

1923. *Anisops calcaratus* Hale, Rec. South Asutralian Mus. vol. II, no. 3, pp. 416-417, text fig. 369.

1933. *Anisops calcaratus*, Lundblad, Arch. für Hydrob. Suppl., vol. XII, p. 145 (a list of Indo-australian and Pacific members of the genus).

As no male specimens of this species were available for study I have chosen to present a copy of the original description.

Male. Head, including eyes, narrower than the pronotum; notocephalon with a median groove, which does not extend to hinder margin of the head and with a swelling on each side; synthlipsis less than 1.5 in vertex, 3.5 times in the width of an eye; notocephalic swellings united at the front of the head and continued on to face as a strong, median carina; eyes large, prominent, projecting slightly in front of vertex. Pronotum sordid testaceous, about 1.5 times wider than long, with a coarse, median carina reaching to posterior margin; lateral margins divergent; hinder edge evenly convex. Scutellum testaceous, wider than long, a little longer than the pronotum. Metanotum testaceous, with a black spot on each side; upper side of abdomen testaceous, posterior segments black. Anterior femora stout, the superior edge with a knife-like ridge, which gradually rises until it attains a point beyond the middle of the length of the thigh, where it abruptly terminates; summit of this ridge set with very small prostrate spines; tibiae strong, the anterior end of the inner face with a distinct spur, in the apex of which is set a short, stout spine; tarsi damaged. Length, nearly 9 mm.; width 2.4 mm.

Female. Eyes not so prominent, and notocephalon wider than in male. Synthlipsis 1.5 in vertex, 3 times in the width of an eye. Pronotum about twice as long, with a coarse, median carina, hinder margin convex. Scutellum pale yellow to orange; sometimes with a black spot on each side anteriorly; 1.5 times as long as the pronotum. Anterior femora not ridged on superior edge; anterior tibia one-fourth longer than the tarsi, the first tarsal segment nearly twice as long as the second, which is less than twice the length of the longest claw. Length, 8 mm. to 9.5 mm.; width 2.5 mm. to 3 mm.

Hab. South Australia; Bordertown (J. G. O. Tepper, type locality); Queensland: Cunnamulla (H. Hardcastle).

The type which is somewhat damaged, is the only male of this distinct species as yet received. The convex posterior margin of the pronotum distinguishes it from all other Australian forms, excepting possibly *A. endymion* Kirk.; in the description of the last named species the character of the hinder edge of the pronotum is not

stated but the synthlipsis is described as about half of the width of an eye and but slightly narrower than the vertex, while the pronotum is relatively longer and the scutellum shorter than in the female of *A. calcaratus.*

Location of types.—Male type located in the South Australian Museum.

Anisops canariensis canariensis Noualhier

1893. *Anisops canariensis* Noualhier, Ann. Soc. Ent. France, p. 18.

1899. *Anisops canariensis*, Puton, Rev. Ent., vol. XVIII, p. 80.

1904. *Anisops canariensis*, Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 117, 132.

1922. *Anisops canariensis*, Lindberg, Notulae Entomologicae, vol. II, pp. 47, 48, text fig. 4 (brief description and sketch of head).

1932. *Anisops canariensis*, Poisson, Bull. Soc. Ent. France, vol. XXVII, p. 42.

1948. *Anisops canariensis canariensis*, Poisson, Inst. Rech. Sahariennes Universite D'Alger, p. 5, text figs. 14, b. d (places *A perplexa* Poisson as a subspecies of *A. canariensis* Noualhier).

This species was not present in the material at my disposal. Therefore, I shall present a translation of the original.

Anisops canariensis n. sp.—Canary: pools of Tamaraceite, mountain stream between Tafira and San Lorenzo; Tenerife; Laguna.

Testaceous, very pale dorsally, with the elytra translucent. Ventrally, varies from black to testaceous. Head of male and female similar, the former having only the clypeus a little strumose. Eyes very large; their sides almost parallel, seen from above; as advanced as the frons (while, with *A. producta*, the frons is always visible in regarding the insect in profile, here it is the anterior border of the eye which forms, in this position, the anterior border of the head). Pronotum a good third shorter than the scutellum. The remainder, as with *A. producta*, from which in addition it distinguishes itself by the smaller size and the less pronounced dorsal body longitudinal curvature. Length 6½-7 mm.

Anterior tibiae enlarged, with a red tooth at the internal base.

Location of types.—Type material from the Canary Islands in the Paris Museum.

Anisops ciliata Stål

1868. *Anisops ciliatus* Stål, Ofver. Kongl. Veten. Akad. Fordhandl., vol. VII, p. 137. (*nec Notonecta ciliata* Fabricius).

1898. *Anisops ciliata*, Kirkaldy, Annal. Mus. Civ. Stor. Nat. Genova, vol. XXXIX, p. 145 (determined in error; probably *A. pellucens*, Gerstaecker).

1933. *Anisops ciliata*, Lundblad, Arch. für Hydrob., Suppl. vol. XII, p. 164 (points out that *Notonecta ciliata* Fabricius is actually an *Enithares*).

This species was not present in the material at my disposal. Therefore, I shall present a translation of the original description.

Dirty, yellowish-white; with the penultimate joint of the rostrum

above, with all the last joint, the venter, all these dark, with a slanting white band before the coxae, connexivum spotted; ventral carina yellowish-white.

The head seen from above or from the side not projecting very far before the eyes, with the vertex and frons narrow, with the base, on this side below the middle rather narrow and almost equally broad, with that base very lightly furrowed. Thorax light, a little narrowed in front. Scutellum light. Hemelytra seen against the light, very lightly punctuated. The claws of the front tarsi somewhat short, the claw on the outside scarcely longer than the inner claw.

Very much akin to *Anisops australis*, with the back of the abdomen pale, with the head lightly furrowed, somewhat narrower vertex and frons, with thoracic carina broad, obtuse, missing in front, with anterior margin broadly angulate, apex projecting in a broad angle between the eyes (not truncate in the same place), with the exterior claw of the front tarsi scarcely longer than the inner claw.

Location of types.—Lundblad (*loc. cit.*) states that Stål's specimens of *Anisops ciliatus* which were in the Copenhagen Museum have been destroyed.

Remarks:—This species along with many others was inaccurately placed as a synonym of *Anisops nivea* (Fabricius) by Kirkaldy (*loc. cit.*). In an effort to clear up the confusion that has resulted it has been necessary to take these species out of synonomy and place them again as valid species. This I have done in regard to *Anisops ciliata.*

Anisops endymion Kirkaldy

1904. *Anisops endymion* Kirkaldy, Wiener Ent. Zeit., vol. XXIII, pp. 112, 132.

1923. *Anisops endymion,* Hale, Rec. South Australian Mus., vol. II, p. 417 (translation of the original description).

1924. *Anisops endymion,* Hale, Proc. Linn. Soc. New South Wales, vol. XLIX, pt. 4, p. 465 (believes that this species may be a *Paranisops* due to pronotol distortion between the eyes and pigmented hemelytra).

1933. *Anisops endymion,* Lundblad, Archiv. für Hydrob., Suppl. vol. XII, p. 145 (a list of Indo-australian and Pacific forms of this genus).

As no specimens of this species were available for study, I have chosen to present a translation of the original description.

Elytra ash-coloured, transparent; posterior half of exocorium and the clavus smoke-coloured, anterior half of clavus, basal margin of corium and the basal half of exocorium, black. Veins of wings pale. Metanotum brownish-black, lateral margins pale. Legs pale. Abdomen above dull, pale, in the centre black. Below black. Vertex longitudinally grooved, hardly broader on the anterior margin than

the synthlipsis, the breadth of the latter barely half the width of an eye.

Anterior margin of the pronotum between the eyes much more distorted than in other species (the distorted portion rounded anteriorly); pronotum three-fourths broader than its length, one-half times longer than the scutellum. Anterior and middle tibiae flat and laterally expanded, broader at apex than at base; one-fifth times longer than tarsi, first tarsal segment two-fifths longer than the other, which is two and a half times as long as the claw. Length, 9 mm.; breadth, 3 mm.

Hab. Australia: Swan River (Perth Museum, Scotland).

Only a single female of this distinct species is before me.

Anisops hyalina Fieber

1851. *Anisops hyalinus* Fieber, Abhandl. Konigl. Bohm. Gesells. Wiss., vol. V, pt. 7, p. 482.

This species was not present in any of the material at my disposal, so I have chosen to present a translation of the original description.

1. *A. hyalinus* m.

Back yellowish, basal and two end segments blackish. Upperside of the anterior and middle femora black brown.

From east India (Helfer, Mus. Berol.)

Length 4-⅔-5 Lin. Dirty whitish yellow. Head almost truncate in front. Vertex with a longitudinal furrow. Eyes approach one another at the synthlipsis. Vertex very narrow, triangularly elongate at the end. Third rostral segment as above, fourth entirely brown black. Scutellum triangular, sides of equal length, sides curved. The entire upperside finely punctate, fine and long curly pubescence. Mesa- and meta-sternites black brown as the coxa. Tibia and outer margin of the femora heavily haired. Abdomen black, anal segment yellowish white, the penultimate segment with yellowish spot. Median keel, a white spot in the lateral furrows upon each segment. Connexivum with brown spots.

Bibliographical notes.—Stål (39) in 1868 indicated that this species might be a synonym of *A. ciliata* Stål, and likewise Kirkaldy (30) placed this species as a possible synonym of *A. nivea* (Fab.). Both workers were incorrect, and due to the confusion that existed in regard to *A. nivea* no taxonomist has redescribed the species, though Esaki (7) pointed out that it was not a synonym of *A. nivea* and that Kirkaldy had been mistaken. Whether or not the type is still in the museum as mentioned by Fieber is questionable. It may no longer be in existence.

Comparative notes.—The extremely large size (about 10 mm. a line being one twelfth of an inch) places it within a very small group. However, none of the species of that size have the triangularly elongate vertex as noted by Fieber. *Anisops sardea* H.-S. which is the largest of the species possessing a cephalic horn, is described by Fieber in the same paper as *Anisops productus*. It, however, does not have the narrow vertex as posessed by *A. hyalinus*. The author of this species does not mention whether or not he was describing a female, but nevertheless this species was not present in the vast Indian material I had for study.

Anisops lanceolata Poisson

(Pl. LIII, fig. 87)

1949. *Anisops lanceolata* Poisson, Rev. Francaise Ent., vol. XV, p. 168, text figs. 7A, B, C, D, E.

This species was not present in the material at my disposal. Therefore, I shall present a translation of the original description and copies of the figures.

Anisops lanceolata n. sp.

Body elongate, fusiform. General pigmentation of a flavus yellow with the hemelytra of uniform color, hyaline, transparent and shining. Synthlipsis very narrow in the two sexes; narrower on the males than on the females (about ten to eleven times narrower than the anterior width of the vertex). Scutellum a little longer medianly than the pronotum.

Male: anterior leg, femur—62, tibia—63, tarsus—40, claws—13.

Tibial comb of disassociated elements, irregularly arranged and unequally developed; one or two elements of the comb bifurcated.

Third rostral segment with developed spurs (rostral prong) and profundly striated on the external border.

Length 6.8 mm.; 6.9 mm.

Distr. one male, one female; Crater of Monoun.

Location of types.—Types located in Poisson's collection.

Comparative notes.—This species with its very narrow synthlipsis, shape of the anterior male femur, peculiar stridulatory comb and the male pronotum with its lateral margins almost parallel is strongly suggestive of a close relationship with *Anisops breddeni* Kirkaldy from which it differs in not having the eyes of the males holoptic.

Anisops letitia Hutchinson

(Pl. LIII, fig. 88)

1929. *Anisops letitia* Hutchinson, Ann. South African Mus., vol. XXV, pt. 3, pp. 385-386, Pl. XXIX, fig. 11; Pl. XXXI, fig. 3.

This species was not present in the material at my disposal. Therefore, I shall present a copy of the original description and copies of the figures.

Anisops letitia n. sp.

Yellowish-white, with apical part of dorsum abdominis and venter abdominis dark.

Fusiform, less than four times as long as wide, broadest before the middle, at about the first fourth of the elytra; pronotum narrower than the greatest width of the body, but slightly wider than that of the head and eyes.

Head and eyes large; notocephalon with a longitudinal depression between two slightly swollen areas along its anterior half, not reaching vertex and spreading out posteriorly before another indefinite raised area. Facial tubercle well marked and often impressed at the sides. Vertex about one fourth as wide as head and eyes and two and one half to three and one half times as wide as the synthlipsis. Pronotum smooth with a few pale hairs, less than twice as wide as long, longer than the scutellum in some species (type) shorter in others, carinated posteriorly, the carina not reaching the posterior margin and variably produced anteriorly; posterior margin convex, or at most slightly flattened, not sinuate or emarginate.

Scutellum fairly rugosely punctured.

Male: Third joint of rostrum with short prongs.

Anterior tibia just over one-half as long again as the tarsus, which is about two and one-half times as long as the longer claw. Tibia rather flattened, anterior margin with three spinous hairs basally, posterior margin with two of its basal hairs elongate.

Stridulatory comb very small, about one-twentieth of the length of the tibia, subparallel sided, of about sixteen lamellae. Tarsus with a spinous hair and a few very small peg-like hairs basally.

Intermediate tibia just under two and one-third times as long as the first (1 and 2) tarsal joint, which is about one and one-fourth to one and one-half times as long as the third; the latter about twice as long as the longer claw.

Posterior tibia one and one-third times as long as the tarsus.

Female: Eyes slightly less prominent than in the male.

Anterior tibia slightly shorter than in males, nearly two and one-

half times as long as the first (1 and 2) tarsal joint, which is about one-half as long again as the second longer claw, rather over one-half as long as the latter.

Intermediate tibia just over twice as long as the first (1 and 2) tarsal joint, which is just under one and one-fourth times as long as the third, the latter being about two and three-fifths as long as the longer claw.

Posterior tibia about one and one-third as long as the tarsus.

Length: 8-9 mm.

Cape; Hovieson's Poort, near Grahanstown.

This very distinct species may be recognized at once by the convex or straight posterior border to the elytra and the small stridulatory comb. It is evidently very local.

Location of types.—Type material located in the South African Museum.

Comparative notes.—This species together with *A. pellucens* Gerst. are the two largest species known from South Africa. However, they are easily separated from one another on the basis of the pronotum which in *A. letitia* is not medianly emarginate as in *A. pellucens.* The synthlipsis of *A. letitia* is less than one half the anterior width of the vertex whereas in *A. pellucens* the synthlipsis is more than one half the anterior width of the vertex.

Anisops mauricensis Poisson

(Pl. LIII, fig. 86)

1945. *Anisops mauricensis* Poisson, Bull. Soc. Ent. France, vol. 50, p. 93, text fig. 7.

This species was not present in the material at my disposal. Therefore, I shall present a translation of the original description and copies of the figures.

Anisops mauricensis n. sp.

Vertex four times wider than the synthlipsis on the males and 2.5 times wider on the females. Head (eyes included) 1.3 times wider than it is long up to the synthlipsis. Pronotum 1.3 times wider than long. Scutellum 1.7 times longer than the pronotum.

General color yellowish brown. Abdominal sternites black in the same way as the metanotum. Lateral spur of the third rostral segment almost two times longer than the body of the segment. Anterior tibia 1.6 times longer than the tarsi; the tibial comb carries 23-24 elongate teeth and the chaetotaxy of the tibia is composed in particular of a short spine on the internal apical surface, followed by three others on the tarsi.

Length 6.5 mm.

Distribution: one male, two females, Ile Mauritius, Curepipe (Ch. Alluaud, 1897).

Observation: The species appears similar to *A. cananariensis* Noualhier, but is differentiated, in particular, by the extreme narrowness of the synthlipsis.

Location of types.—Type material located in Poisson's collection.

Anisops meulenaerei Poisson

(Pl. LIII, fig. 89)

1940. *Anisops meulenaerei* Poisson, Bull. Mus. Royal Hist. Nat. Belgique, vol. XVI, no. 27, pp. 8-10, text figs. 9, 10 ,11, 12.

This species was not present in the material at my disposal. Therefore, I shall present a translation of the original description and copies of the figures.

Anisops meulenaerei n. sp.

General pigmentation flavus.

Back of the abdomen flavus, with the margins of the tergites black. Hemelytra hyaline and transparent. Eyes globose and slate colored. Synthlipsis two times narrower than the anterior width of the vertex. Pronotum 1.5 to 1.6 times wider than long; 2.85 times longer than the scutellum. Third rostral segment provided with short spurs.

Anterior leg: claws 3.6 times shorter than the tarsi, which is 1.6 times shorter than the tibia and 1.1 times shorter than the femur; the latter segment being itself 1.4 times shorter than the tibia.

Stridulatory apparatus with 23 long teeth and associated with a strong, spiny tubercle situated at the beginning of a row of seven long bristles. A strong spine at the extremity (tarsal) of the anterior femur. The anterior tarsus carries five spines distributed regularly.

Length 9.5 mm., width 2.5-2.75 mm.

Distribution: Ethopia, Goba: one male, 1934-35 (R. de Meulenaerei), Mus. Roy. Hist. Belgian. 10,738 (type).

Comparative notes.—This species appears to be similar to *Anisops ares* Hutchinson, from which it differs primarily in the chaetotaxy of the male front leg as the latter species lacks the spur adjacent to the stridulatory comb and also in the shape of the anterior male femur which is parallel for its entire length with the apex rounded while in *A. ares* Hutch. only the basal three-fourths is parallel.

Anisops milloti Poisson

(Pl. LIV, fig. 90)

1948. *Anisops milloti* Poisson, Mem. Inst. Scient. Madagascar, Serie A, vol. I, p. 109, text figs. 20, A. B.

This species was not present in the material at my disposal. Therefore, I shall present a translation of the original description and copies of the figures.

Anisops (A) milloti n. sp.

General color flavus (after standing in alcohol at 70 degrees), eyes dark maroon. Abdominal sternites dark brown. Body very fusiform. Head including the eyes, slightly wider than the pronotum and, viewed dorsally, a little shorter than the pronotum (1.13 times shorter); pronotum 1.10 times shorter than the scutellum and nearly two times wider at the base than its median length. Synthlipsis four times narrower than the anterior width of the vertex. Facial tubercle very prominent, overhanging the base of the rostrum. Appendages of the third rostral segment well developed and rounded at their extremity. Anterior tibia and middle tibia rather dilated and flattened.

Male, anterior leg: femur—22, tibia—37.5, tarsus—23, claws—13.

Stridulatory comb rather well developed, represented by a groove embelished with long thin bristles and with 7-8 spatulate setae.

Distribution: Three males Angavokely, Madagascar.

Comparative notes: The ventral projection of the facial tubercle is suggestive of the similar condition found on the males of *A. wakefieldi* White, however, in the latter case the projection is strongly accuminate and not truncate as in this species. Also the rostral prongs of the third rostral segment of the males of *A. wakefieldi* are very short, only about one-fourth the length of the third rostral segment whereas those of *A. milloti* appear to be at least as long as the third rostral segment.

Location of types.—Type material located in Poisson's collection.

Anisops ocularis Hale

1923. *Anisops ocularis* Hale, Rec. South Australian Mus. vol. II, no. 3, pp. 412-413, text fig. 366.

1933. *Anisops ocularis*, Lundblad Arch. für Hydrob. Suppl. vol. XII, p. 145 (a list of Indo-australian and Pacific forms of this genus).

This species was not present in the material at my disposal. Therefore, I shall present a translation of the original description.

Head, including the large and prominent eyes, very slightly narrower than the pronotum; notocephalon with a swelling on each

side, not reaching to base of head, converging at vertex and continued as median carina on to the very narrow face; synthlipsis about 1.5 in vertex, 5 times in the width of an eye. Pronotum pale testaceous; as long as the head, twice as wide as long, with a feeble median carina, which disappears posteriorly; hinder edge slightly concavely incised. Scutellum testaceous, with a large, pale triangular patch near each anterior angle; wider than long, and about 1.25 times as long as the pronotum. Metanotum testaceous; upperside of abdomen pale, with the posterior segments in parts black. Underside of abdomen black, ventral carina and lateral edges ochraceous. Anterior tibiae much expanded, the greatest width (near the base) being .3 of the length; anterior tarsi 1.6 times in tibiae, 3 times longer than the longer claw. Length, 8 mm.; width, 2.5 mm.

Hab. Northern Territory: Darwin (W. K. Hunt).

The type is the only representative of this species before me. As in *A. doris,* the eyes are large, the notocephalon is narrow, and the pronotum is short; it differs, however, in the wider synthlipsis, the markedly more robust form, the much more expanded anterior tibiae of the male, etc. It resembles Distant's description and figure of *A. cleopatra* from New Caledonia, but in that species the synthlipsis is "not more than half" as wide as the vertex and the size is smaller.

Location of types.—Male type located in the South Australian Museum.

Anisops pugnax Poisson

(Pl. LIV, fig. 92)

1945. *Anisops pugnax* Poisson, Bull. Soc. Ent. France, vol. 50, p. 94, text fig. 8.

This species was not present in the material at my disposal. Therefore, I shall present a translation of the original description and copies of the figures.

Anisops pugnax n. sp.

Female: vertex 1.7 times wider than the synthlipsis. Head 2.5 times wider than long. Pronotum 2.3 times wider than long; its posterior margin slightly concave. Scutellum 1.2 times shorter than its basal width and 1.5 times longer than the pronotum.

Vertex, pronotum as well as the legs, yellowish. Scutellum black. Scutellar border of the hemelytra as well as the internal margin of the hemelytral pit, trimmed with carmin. Metanotum and the last abdominal tergites black, the others yellowish; abdominal sternites black.

Male: anterior tibia 1.2 times longer than the tarsus. The tibial comb is formed of 12 irregular teeth.

Length: 7.5 mm.—male; 8 mm.—female.

Distribution: one male, one female, Mt. Kenia (C. & N. O.); lower zone, prairies, 2000m. (C. Alluaud. 1908).

Location of types.—Types destroyed during the war.

Comparative notes.—The cylindrical distinct teeth of the stridulatory comb are similar to those found in *A. adonis* though in the latter case there are approximately seven instead of the twelve of *A. pugnax*. This species is much larger than *A. adonis* and the anterior male tibia is one and two tenths the length of the anterior tarsus whereas the anterior male tibia of *A. adonis* is one and one half the length of the fore tarsus.

Anisops worthingtoni Jaczewski

(Pl. LIV, fig. 91)

1933. *Anisops worthingtoni* Jaczewski, Linn. Soc. Jour., vol. XXXVIII, pp. 343-345, text figs. 1, 2, 3, 4, 5.

1935. *Anisops worthingtoni*, Poisson, Mus. Nat. Hist. Nat. vol. III, p. 211, fig. 25, a, b (ecological note).

This species was not present in the material at my disposal. Therefore, I shall present a copy of the original description and copies of the figures.

Anisops (Anisops) worthingtoni sp. n.

Lake Rudolf, stn. 280, 1 male, 1 female.

Length 6.5 mm. Yellowish white, fairly slender.

Head of the male produced in front into a distinct prominence, resembling that of the Australasian *A. fieberi* Kirk. (Hale, 1923), much smaller, however, than the cephalic prominence in *A. sardea* H. S. At its apex some elongated dark hairs are inserted. Face of the male flattened. Head of the female simple, vertex forming a very slight, but easily discernible convex prominence between the eyes, when seen from above. Vertex in both sexes a little over three times as wide as the synthlipsis. Rostral prongs of the males moderately divergent.

Trochanter of the front legs of the male armed with two groups of short, slightly curved pegs, one at the basal prominence, the other at the lower margin. Tibial prong with about fifteen lamellae. Outer margin of the tibia with two thickened spines and a short peg inserted more distally. Inner margin with three long basal bristles and a number of shorter ones. Tarsal joint with a continuous row of short spines along its outer margin. Tibia one and one-fourth

times as long as the tarsus, which is twice as long as the longer claw.

Sinistral spine of the seventh abdominal segment of the male thickened in its basal portion, curved and tapering towards the apex. Parameres as shown in the text figure.

This species differs at once from all other African representatives of the genus by the structure of the head and of the front legs in the males, the females may be recognized by their slightly prominent vertex.

I have pleasure in dedicating this species to Dr. E. B. Worthington, its discoverer.

Location of types.—Type material in Cambridge Museum.

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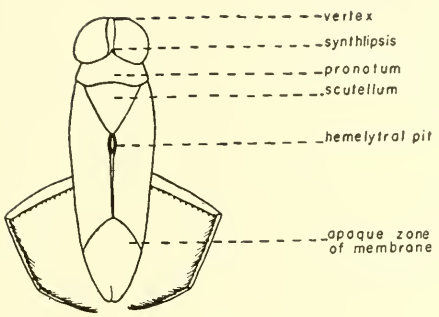
PLATE XXXVI

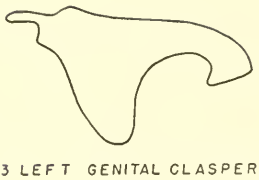
FIGURE

1. Male Anisops—dorsal view.
2. Male Anisops—ventral view.
3. Left genital clasper.
4. Right genital clasper.
5. *Anisops elstoni* n. sp.
   - 5a. Inner surface view of male left fore leg.
   - 5b. Left lateral view of third and fourth male rostral segments.
   - 5c. Enlarged view of left stridulatory comb.
6. *Anisops amaryllis* Hutchinson.
   - 6a. Inner surface view of male left fore leg.
   - 6b. Left lateral view of third and fourth male rostral segments.
   - 6c. Enlarged view of left stridulatory comb.
7. *Anisops agalia* Hutchinson.
   - 7a. Inner surface view of male left fore leg.
   - 7b. Enlarged view of left stridulatory comb.

PLATE XXXVI

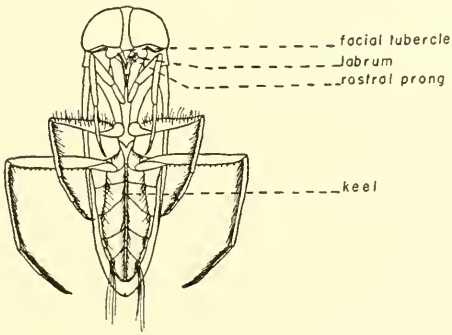


1. MALE ANISOPS (dorsum)

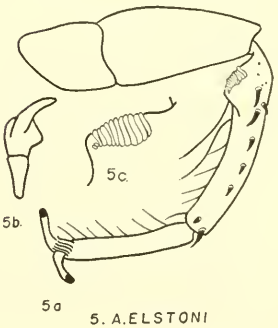


3 LEFT GENITAL CLASPER

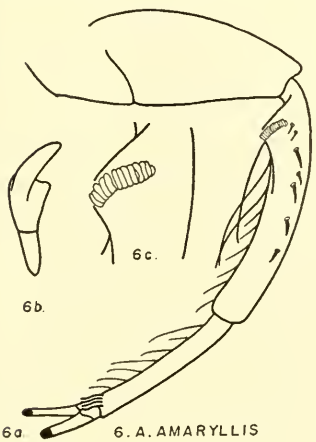
4. RIGHT GENITAL CLASPER



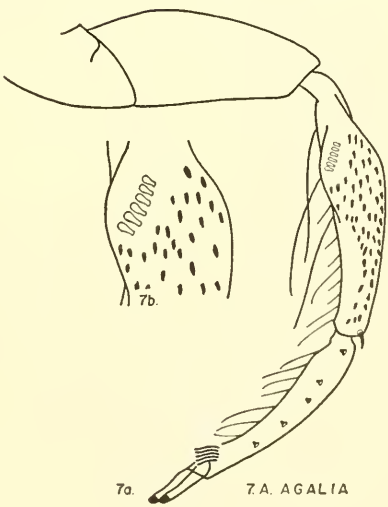
2 MALE ANISOPS (venter)



5. A. ELSTONI



6. A. AMARYLLIS



7. A. AGALIA

PLATE XXXVII

FIGURE

8. *Anisops campbelli* n. sp.
   - 8a. Inner surface view of male left fore leg.
   - 8b. Left view of third and fourth male rostral segments.
   - 8c. Enlarged view of left stridulatory comb.
9. *Anisops stali* Kirkaldy.
   - 9a. Inner surface view of male left fore leg.
   - 9b. Enlarged view of left stridulatory comb.
10. *Anisops eros* Hutchinson.
   - 10a. Inner surface view of male left fore leg.
   - 10b. Left view of third and fourth male rostral segments.
   - 10c. Enlarged view of left stridulatory comb.

PLATE XXXVII

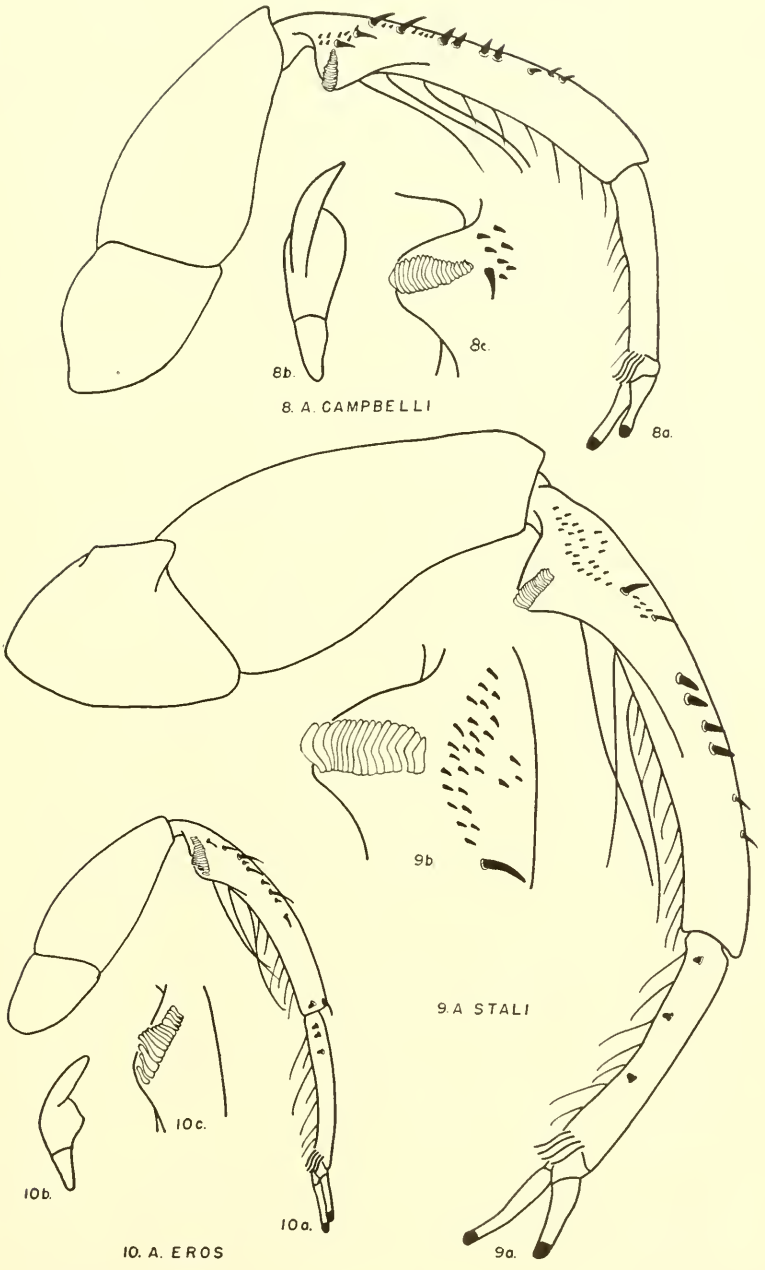


PLATE XXXVIII

FIGURE

11. *Anisops tuberculata* Poisson.
    - 11a. Inner surface view of male left fore leg.
    - 11b. Enlarged view of left stridulatory comb.
12. *Anisops paracrinita* n. sp.
    - 12a. Inner surface view of male left fore leg.
    - 12b. Left view of third and fourth male rostral segments.
    - 12c. Enlarged view of left stridulatory comb.
13. *Anisops hackeri* n. sp.
    - 13a. Inner surface view of male left fore leg.
    - 13b. Left view of third and fourth male rostral segments.
    - 13c. Enlarged view of left stridulatory comb.
14. *Anisops nodulata* n. sp.
    - 14a. Inner surface view of male left fore leg.
    - 14b. Left view of third and fourth male rostral segments.
    - 14c. Enlarged view of left stridulatory comb.
15. *Anisops kampalensis* Hutchinson.
    - 15a. Inner surface view of male left fore leg.
    - 15b. Left view of third and fourth male rostral segments.
    - 15c. Enlarged view of stridulatory comb.
16. *Anisops hyperion* Kirkaldy.
    - 16a. Inner surface view of male left fore leg.
    - 16b. Left view of third and fourth male rostral segments.
    - 16c. Enlarged view of left stridulatory comb.

PLATE XXXVIII

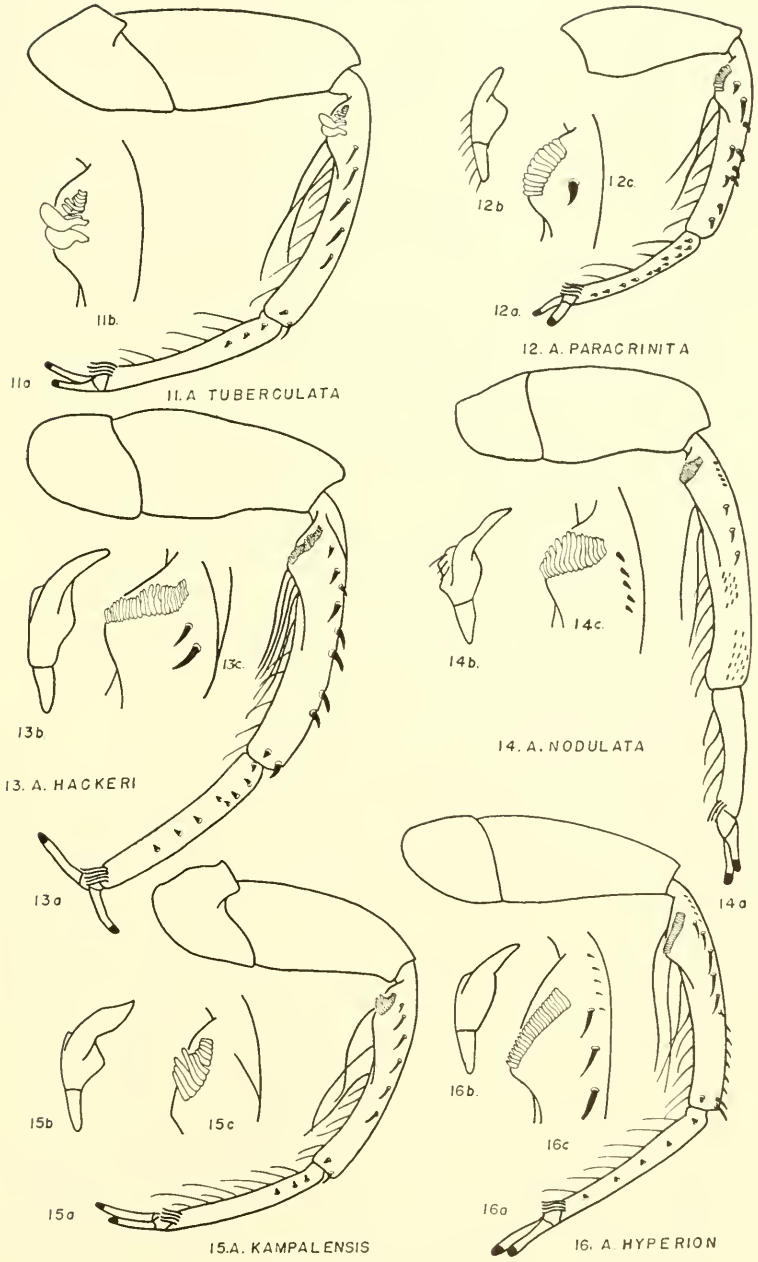


PLATE XXXIX

FIGURE

17. *Anisops apicalis* Stål.
    - 17a. Inner surface view of male left fore leg.
    - 17b. Left view of third and fourth male rostral segments
    - 17c. Enlarged view of left stridulatory comb.
18. *Anisops timorensis* n. sp.
    - 18a. Inner surface view of male left fore leg.
    - 18b. Left view of male rostrum.
    - 18c. Enlarged view of left stridulatory comb.
19. *Anisops edepol* Kirkaldy.
    - 19a. Inner surface view of male left fore leg.
    - 19b. Enlarged view of left stridulatory comb.
20. *Anisops canariensis perplexa* Poisson.
    - 20a. Inner surface view of male left fore leg.
    - 20b. Left view of third and fourth male rostral segments.
    - 20c. Enlarged view of left stridulatory comb.
21. *Anisops coutierei* n. sp.
    - 21a. Inner surface view of male left fore leg.
    - 21b. Left view of third and fourth male rostral segments.
    - 21c. Enlarged view of left stridulatory comb.
22. *Anisops occipitalis* Breddin.
    - 22a. Inner surface view of male left fore leg.
    - 22b. Left view of third and fourth male rostral segments.
    - 22c. Enlarged view of left stridulatory comb.

PLATE XXXIX

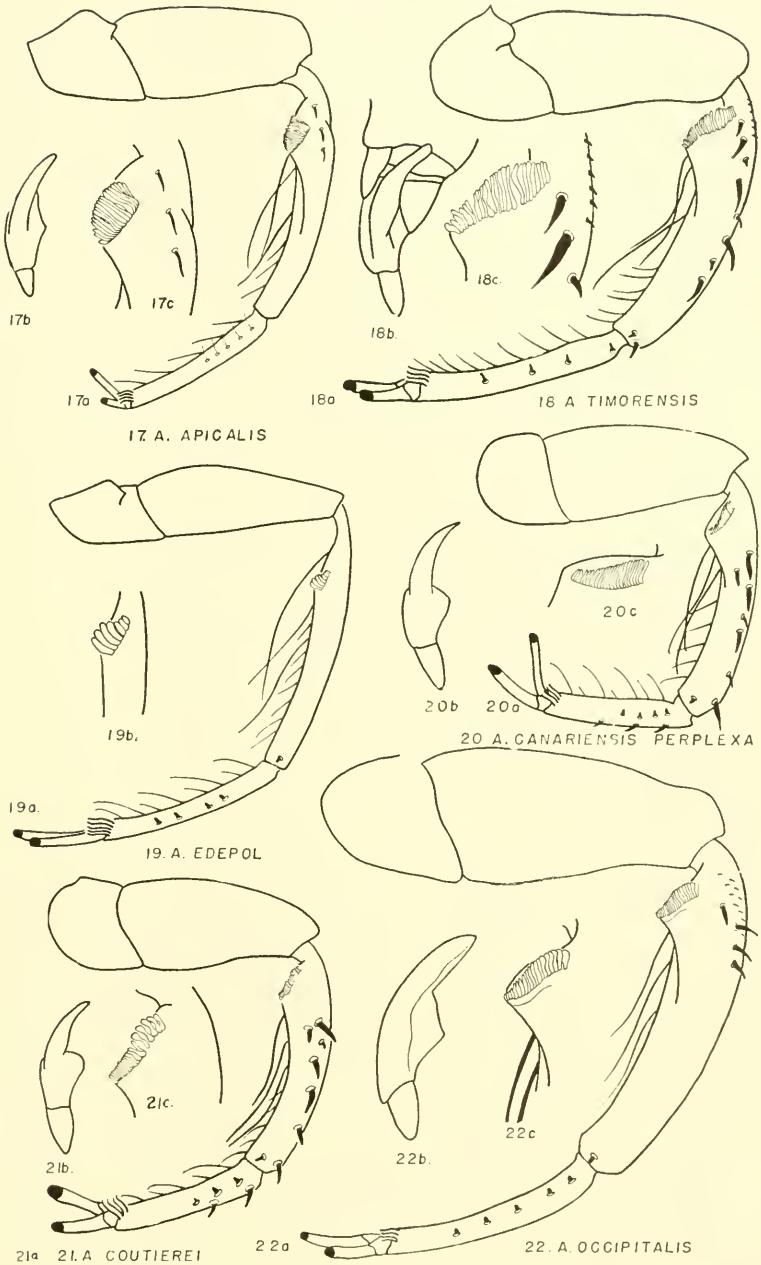

17b
17c
17a
17. A. APICALIS
18c.
18b.
18a
18 A TIMORENSIS
19b.
19a.
19. A. EDEPOL
20c
20b
20a
20 A. CANARIENSIS PERPLEXA
21c.
21b.
21a
21. A COUTIEREI
22b.
22c
22a
22. A. OCCIPITALIS

PLATE XL

FIGURE

23. *Anisops malkini* n. sp.
    - 23a. Inner surface view of male left fore leg.
    - 23b. Left view of third and fourth male rostral segments.
    - 23c. Enlarged view of left stridulatory comb.
24. *Anisops fijiensis* n. sp.
    - 24a. Inner surface view of male left fore leg.
    - 24b. Left view of third and fourth male rostral segments.
    - 24c. Enlarged view of left stridulatory comb.
25. *Anisops jaczewski* Hutchinson.
    - 25a. Inner surface view of male left fore leg.
    - 25b. Left view of third and fourth male rostral segments.
    - 25c. Enlarged view of left stridulatory comb.
26. *Anisops pellucens* Gerstaecker.
    - 26a. Inner surface view of male left fore leg.
    - 26b. Left view of third and fourth male rostral segments.
    - 26c. Enlarged view of left stridulatory comb.

PLATE XL

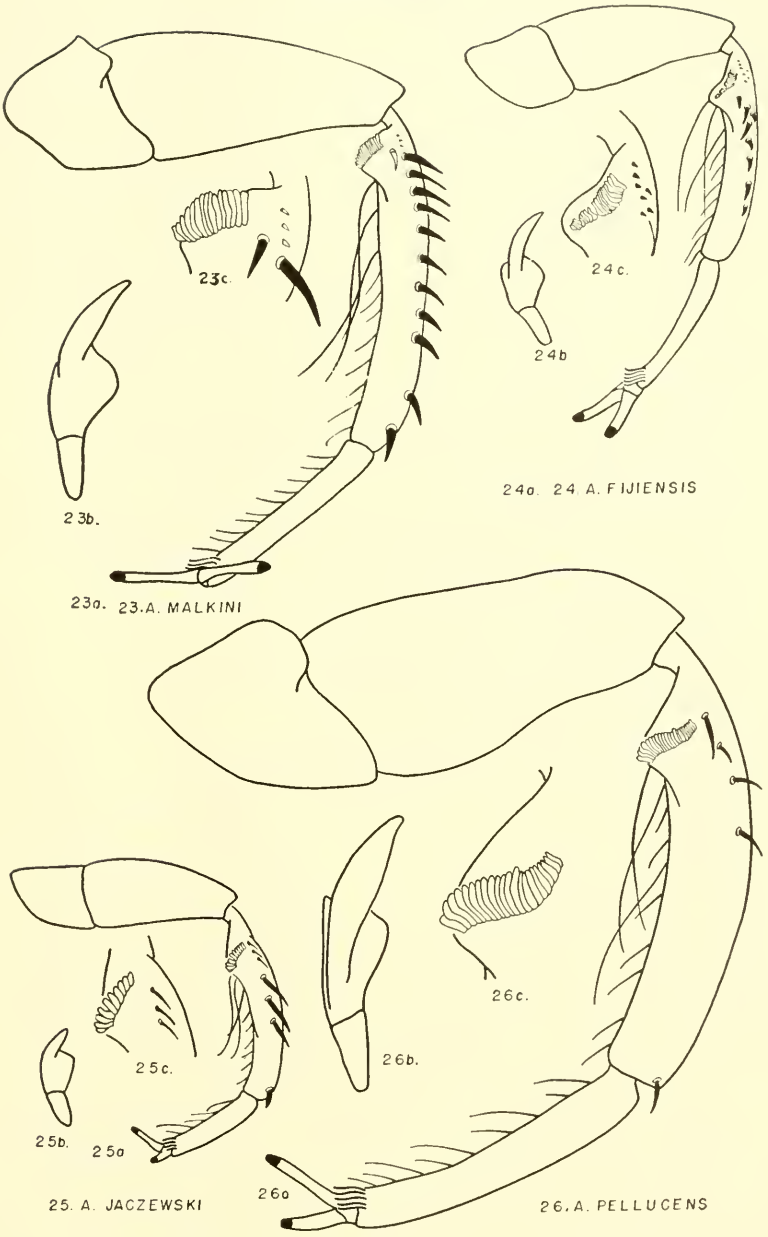
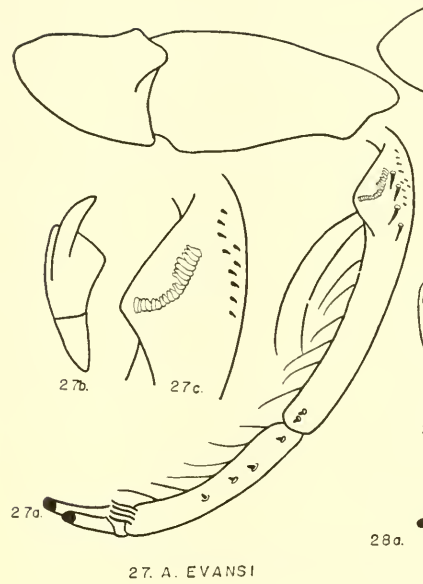

23c.
23b.
23a. 23.A. MALKINI
24c.
24b
24a. 24.A. FIJIENSIS
26c.
26b.
25c.
25b.
25a
25. A. JACZEWSKI
26a
26. A. PELLUCENS

PLATE XLI

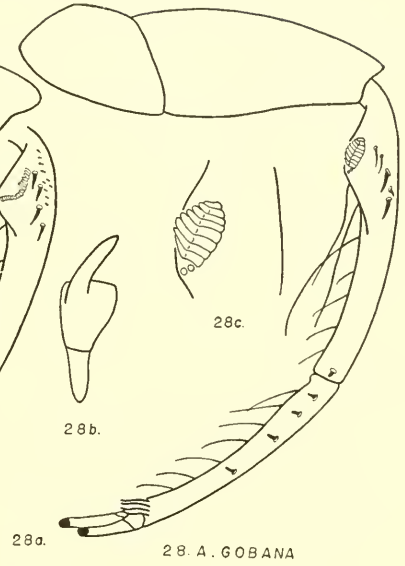
FIGURE

27. *Anisops evansi* n. sp.
    - 27a. Inner surface view of male left fore leg.
    - 27b. Left view of third and fourth male rostral segments.
    - 27c. Enlarged view of the left stridulatory comb.
28. *Anisops gobana* Poisson.
    - 28a. Inner surface view of male left fore leg.
    - 28b. Left view of third and fourth male rostral segments.
    - 28c. Enlarged view of the left stridulatory comb.
29. *Anisops adonis* Hutchinson.
    - 29a. Inner surface view of male fore leg.
    - 29b. Left view of third and fourth male rostral segments.
    - 29c. Enlarged view of the left stridulatory comb.
30. *Anisops robusta* Hutchinson.
    - 30a. Inner surface view of male fore leg.
    - 30b. Left view of third and fourth rostral segments.
    - 30c. Enlarged view of the left stridulatory comb.

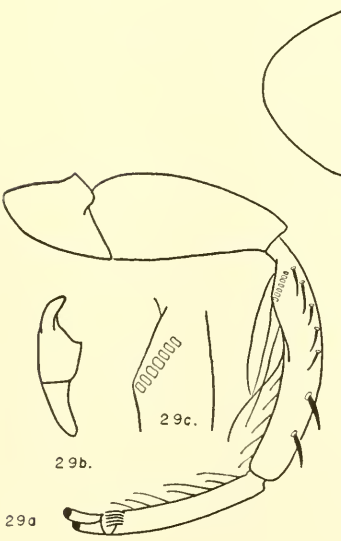
PLATE XLI



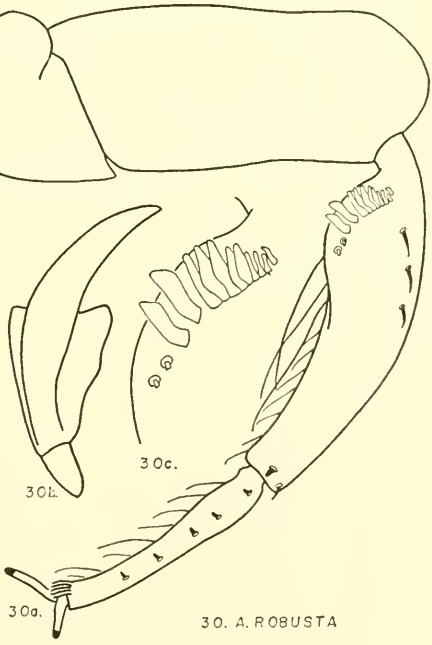
27. A. EVANSI



28. A. GOBANA



29. A ADONIS



30. A. ROBUSTA

PLATE XLII

FIGURE

31. *Anisops gratus* Hale.
    - 31a. Inner surface view of male left fore leg.
    - 31b. Left view of third and fourth male rostral segments.
    - 31c. Enlarged view of left stridulatory comb.
32. *Anisops varia* Fieber.
    - 32a. Inner surface view of male left fore leg.
    - 32b. Left view of third and fourth male rostral segments.
    - 32c. Enlarged view of left stridulatory comb.
33. *Anisops semita* n. sp.
    - 33a. Inner surface view of male left fore leg.
    - 33b. Left view of third and fourth male rostral segments.
    - 33c. Enlarged view of left stridulatory comb.
34. *Anisops sikorensis* n. sp.
    - 34a. Inner surface view of male left fore leg.
    - 34b. Enlarged view of left stridulatory comb.

PLATE XLII

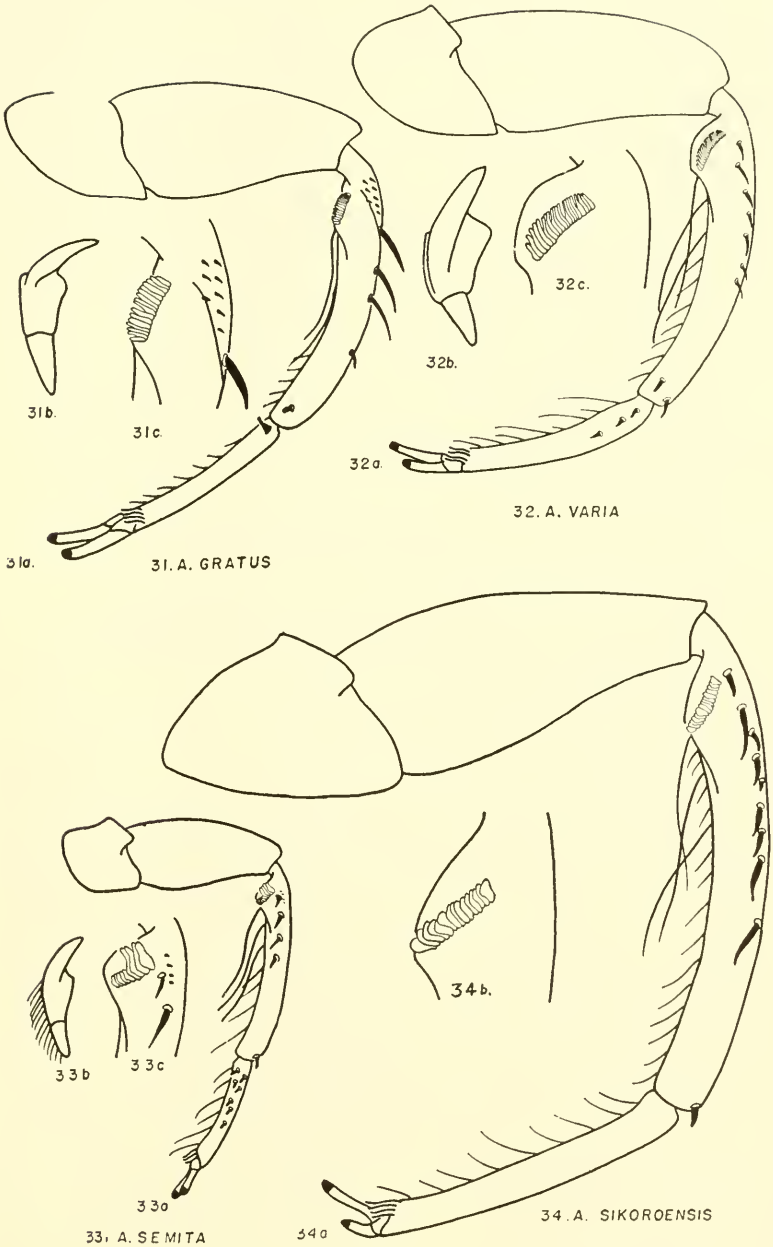

31b.
31c.
31a.
31. A. GRATUS
32b.
32c.
32a.
32. A. VARIA
33b
33c
33a
33. A. SEMITA
34b.
34a
34. A. SIKOROENSIS

PLATE XLIII

FIGURE

35. *Anisops canaliculata* n. sp.
    - 35a. Inner surface view of male left fore leg.
    - 35b. Left view of third and fourth male rostral segments.
    - 35c. Enlarged view of left stridulatory comb.
36. *Anisops genji* Hutchinson.
    - 36a. Inner surface view of male left fore leg.
    - 36b. Left view of third and fourth male rostral segments.
    - 36c. Enlarged view of left stridulatory comb.
37. *Anisops lipovskyi* n. sp.
    - 37a. Inner surface view of male left fore leg.
    - 37b. Left view of third and fourth male rostral segments.
    - 37c. Enlarged view of left stridulatory comb.
38. *Anisops psyche* Hutchinson.
    - 38a. Inner surface view of male right fore leg minus the tarsus.
    - 38b. Left view of third and fourth male rostral segments.
    - 38c. Enlarged view of right stridulatory comb.
39. *Anisops nivea* (Fabricius).
    - 39a. Inner surface view of male left fore leg.
    - 39b. Enlarged view of left stridulatory comb.
40. *Anisops tahitiensis* Lundblad.
    - 40a. Inner surface view of male left fore leg.
    - 40b. Left view of third and fourth male rostral segments.
    - 40c. Enlarged view of left stridulatory comb.

PLATE XLIII

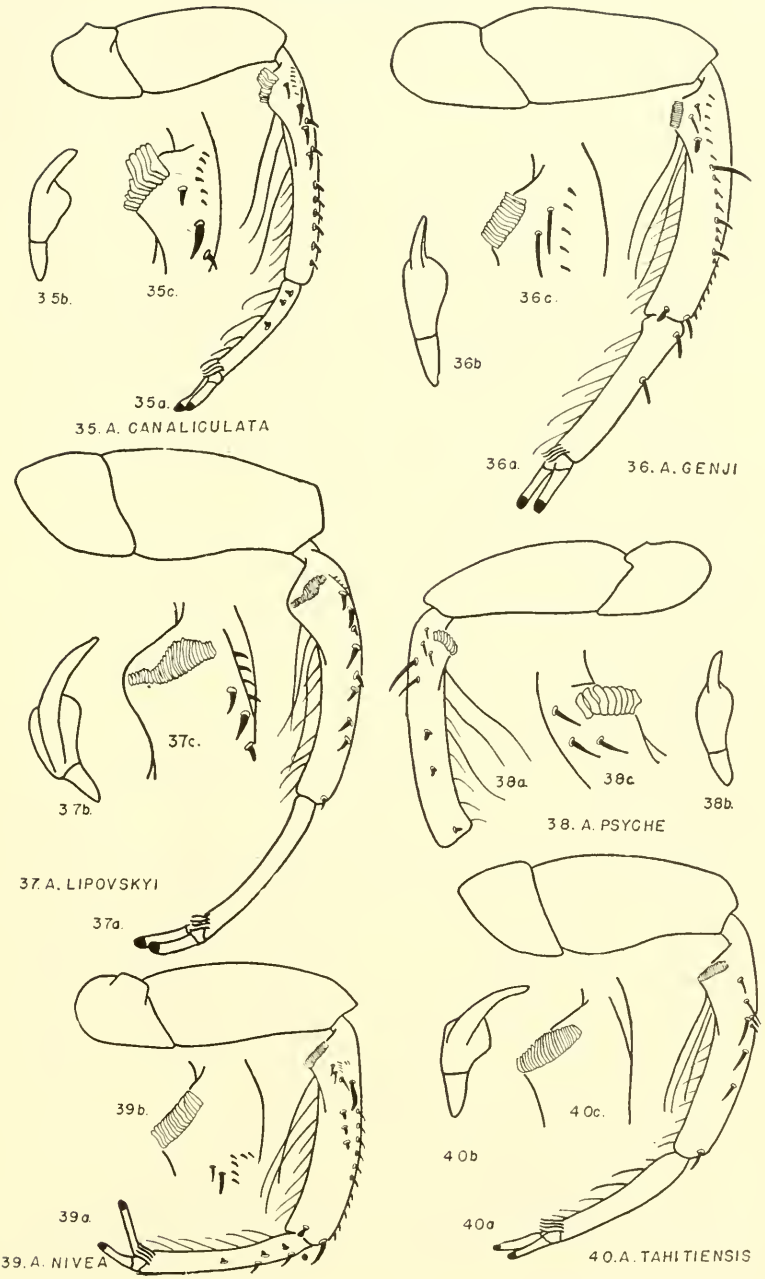

35b.
35c.
35a.
35. A. CANALICULATA
36c.
36b
36a.
36. A. GENJI
37c.
37b.
37. A. LIPOVSKYI
37a.
38a.
38c
38b.
38. A. PSYCHE
39b.
39a.
39. A. NIVEA
40c.
40b
40a
40. A. TAHITIENSIS

PLATE XLIV

FIGURE

41. *Anisops praetexta* Hutchinson.
    41a. Inner surface view of male left fore leg.
    41b. Left view of third and fourth male rostral segments.
    41c. Enlarged view of left stridulatory comb.
42. *Anisops barrenensis* n. sp.
    42a. Inner surface view of male left fore leg.
    42b. Left view of third and fourth male rostral segments.
    42c. Enlarged view of left stridulatory comb.
43. *Anisops cleopatra* Distant.
    43a. Inner surface view of male left fore leg.
    43b. Left view of rostrum.
    43c. Enlarged view of left stridulatory comb.
44. *Anisops philippinensis* n. sp.
    44a. Inner surface view of male left fore leg.
    44b. Left view of third and fourth male rostral segments.
    44c. Enlarged view of left stridulatory comb.
45. *Anisops deanei* n. sp.
    45a. Inner surface view of male left fore leg.
    45b. Left view of third and fourth male rostral segments.
    45c. Enlarged view of left stridulatory comb.
46. *Anisops tanalensis* n. sp.
    46a. Inner surface view of male left fore leg.
    46b. Left view of third and fourth male rostral segments.
    46c. Enlarged view of left stridulatory comb.

PLATE XLIV

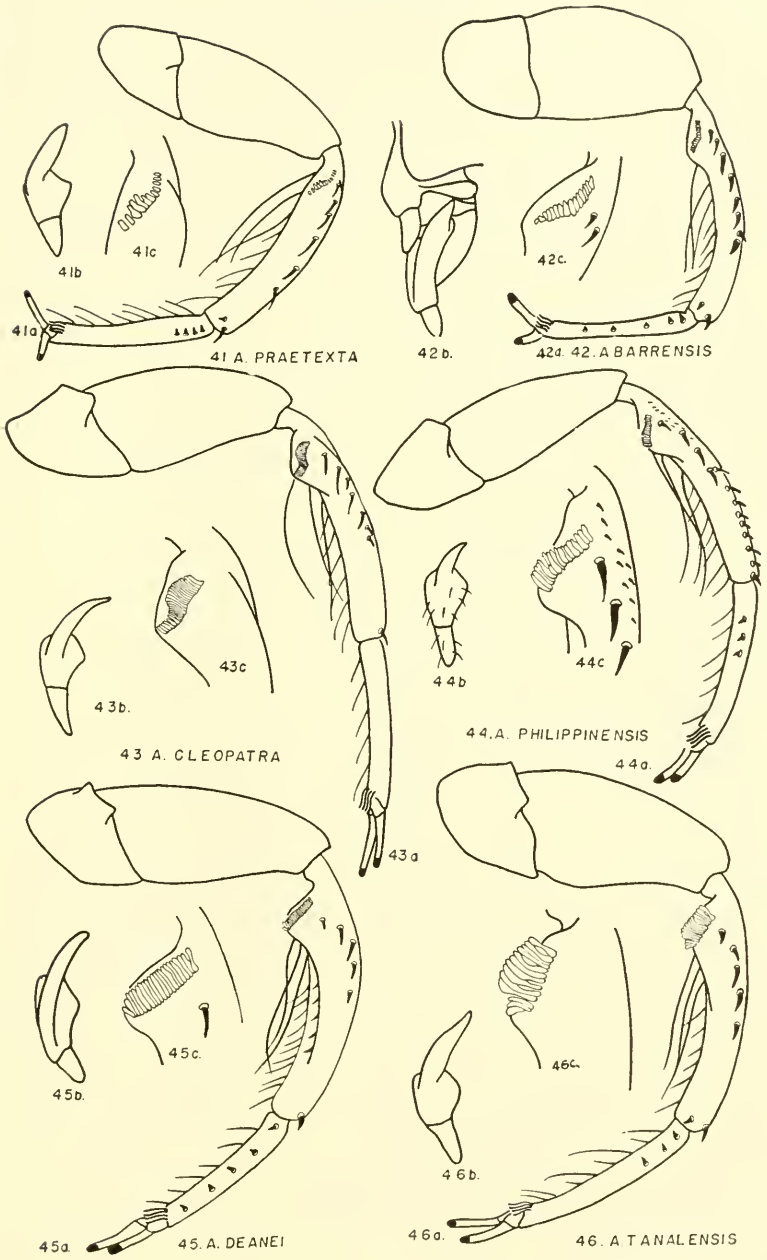
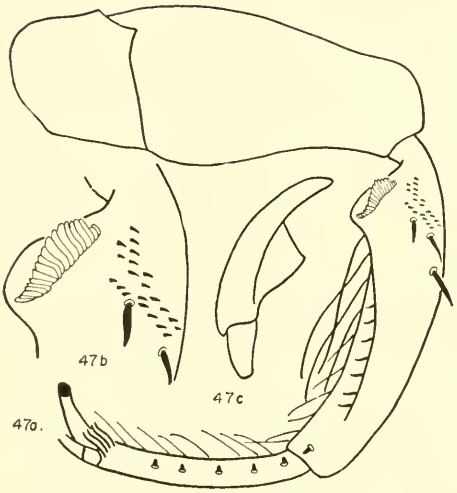

41b
41c
41a
41 A. PRAETEXTA
42b.
42c.
42d. 42. A BARRENSIS
43c
43b.
43 A. CLEOPATRA
43a
44b
44c
44 A. PHILIPPINENSIS
44a.
45c.
45b.
45a.
45. A. DEANEI
46c.
46b.
46a.
46. A TANALENSIS

PLATE XLV

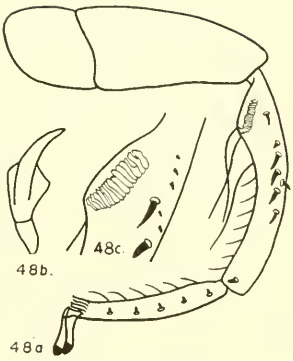
FIGURE

47. *Anisops leucothea* Esaki.
    - 47a. Inner surface view of left male fore leg.
    - 47b. Enlarged view of left stridulatory comb.
    - 47c. Left view of third and fourth male rostral segments.
48. *Anisops windi* n. sp.
    - 48a. Inner surface view of left male fore leg.
    - 48b. Left view of third and fourth male rostral segments.
    - 48c. Enlarged view of left stridulatory comb.
49. *Anisops biroi* n. sp.
    - 49a. Inner surface of left male fore leg.
    - 49b. Left view of third and fourth male rostral segments.
    - 49c. Enlarged view of left stridulatory comb.
50. *Anisops grandis* Poisson.
    - 50a. Inner surface view of left male fore leg.
    - 50b. Left view of third and fourth male rostral segments.
    - 50c. Enlarged view of left stridulatory comb.

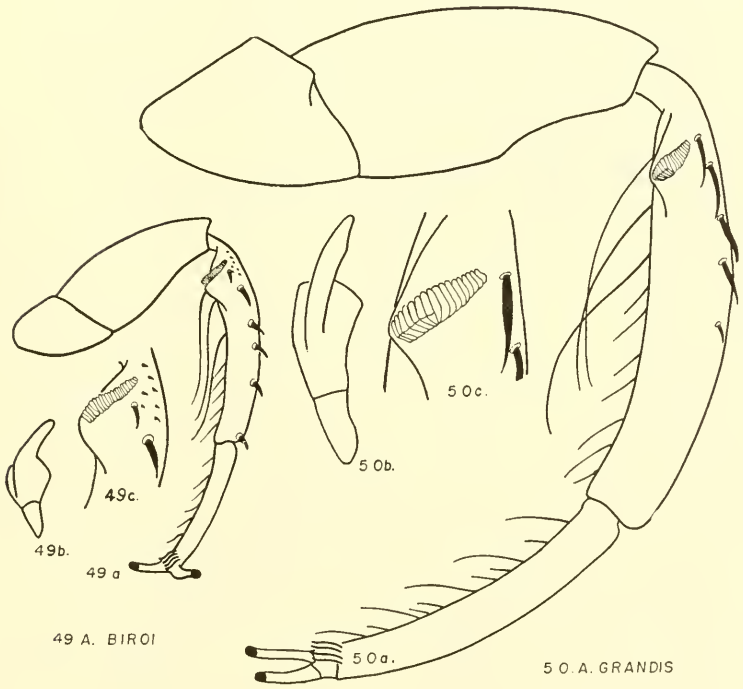
PLATE XLV



47. A. LEUCOTHEA



48 A. WINDI



49 A. BIROI

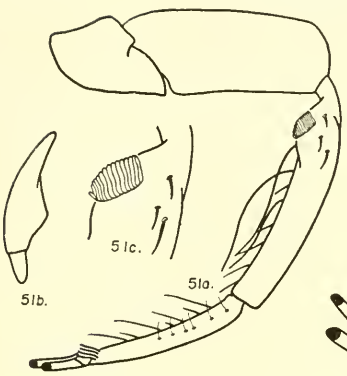
50. A. GRANDIS

PLATE XLVI

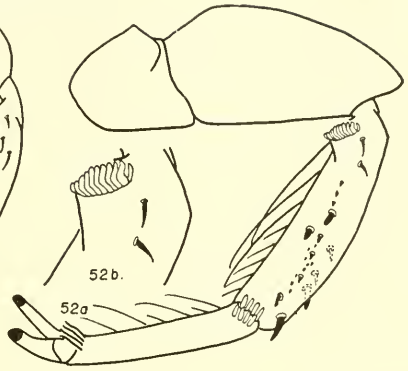
FIGURE

51. *Anisops hungerfordi* Poisson.
    - 51a. Inner surface view of male left fore leg.
    - 51b. Left view of third and fourth male rostral segments.
    - 51c. Enlarged view of left stridulatory comb.
52. *Anisops hancocki* Hutchinson.
    - 52a. Inner surface view of male left fore leg.
    - 52b. Enlarged view of left stridulatory comb.
53. *Anisops doris* Kirkaldy.
    - 53a. Inner surface view of male left fore leg.
    - 53b. Left view of third and fourth male rostral segments.
    - 53c. Enlarged view of left stridulatory comb.
54. *Anisops barbata* n. sp.
    - 54a. Inner surface view of male left fore leg.
    - 54b. Left view of third and fourth male rostral segments.
    - 54c. Enlarged view of left stridulatory comb.

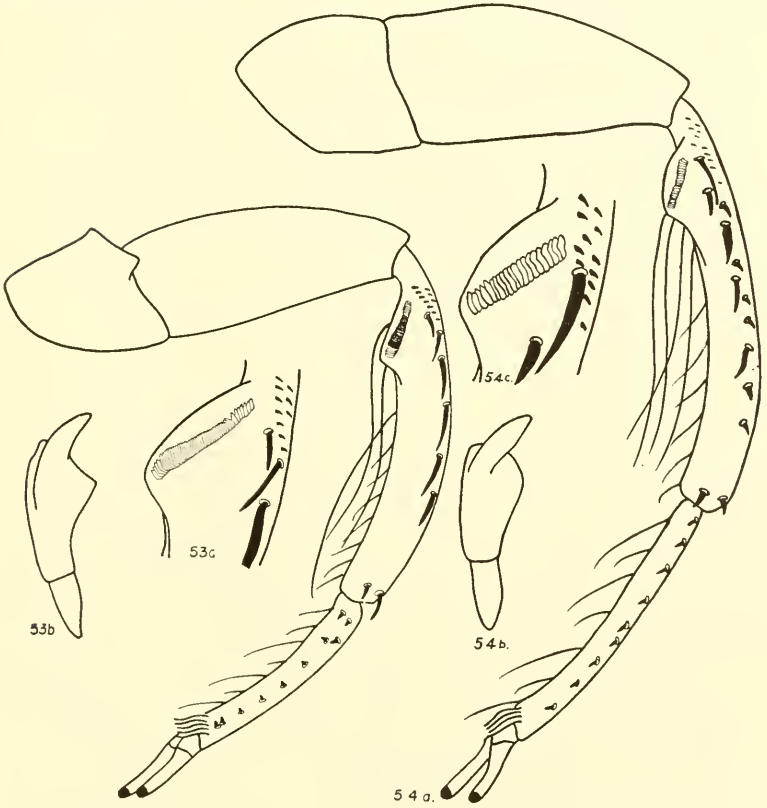
PLATE XLVI



51. A. HUNGERFORDI



52. A. HANCOCKI



53. A. DORIS

54. A. BARBATA

PLATE XLVII

FIGURE

55. *Anisops wakefieldi* White.
    55a. Inner surface view of male left fore leg.
    55b. Enlarged view of left stridulatory comb.
56. *Anisops nigrolineata* Lundblad.
    56a. Inner surface view of male left fore leg.
    56b. Enlarged view of left stridulatory comb.
57. *Anisops ares* Hutchinson.
    57a. Inner surface view of male left fore leg.
    57b. Left view of third and fourth male rostral segments.
    57c. Enlarged view of left stridulatory comb.
58. *Anisops tasmaniaensis* n. sp.
    58a. Inner surface view of male left fore leg.
    58b. Left view of third and fourth male rostral segments.
    58c. Enlarged view of left stridulatory comb.

PLATE XLVII

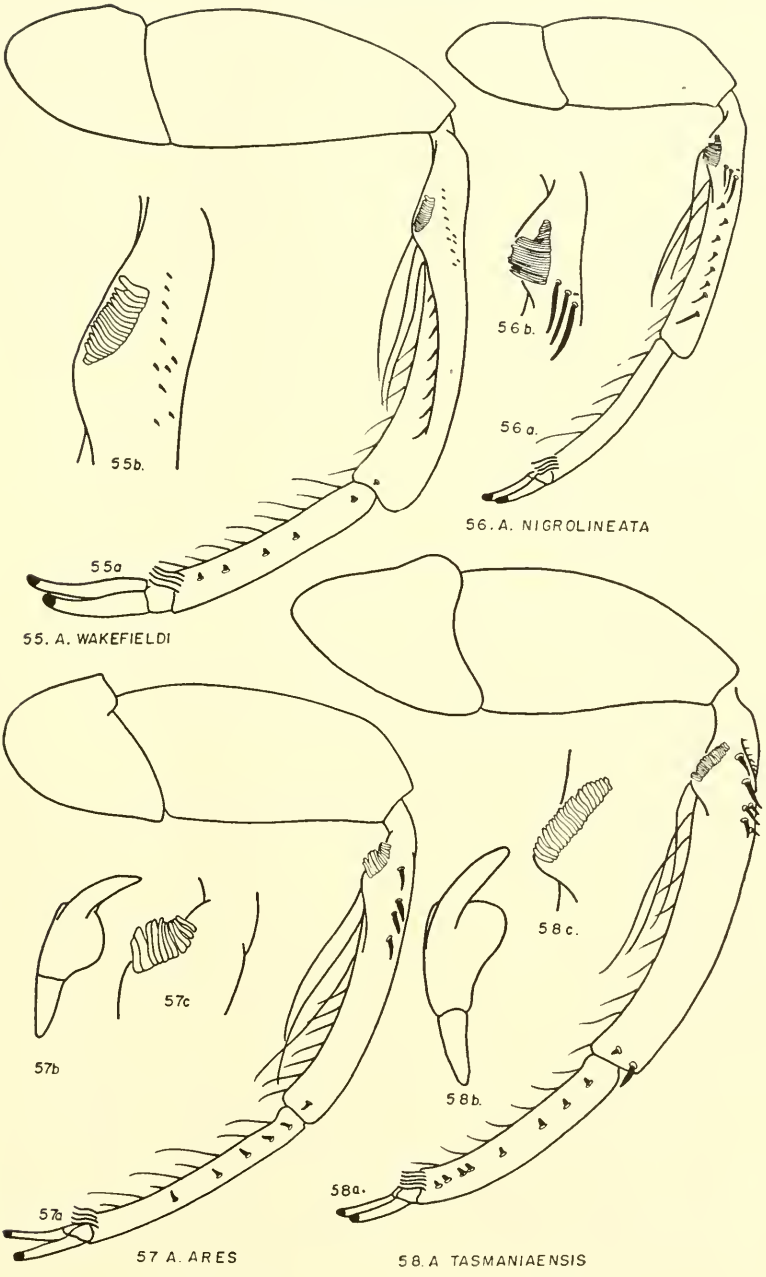

55b.
55a
55. A. WAKEFIELDI
56b.
56a.
56. A. NIGROLINEATA
57c
57b
57a
57 A. ARES
58c.
58b.
58a.
58. A TASMANIAENSIS

PLATE XLVIII

FIGURE

59. *Anisops paranigrolineata* n. sp.
    - 59a. Inner surface view of male left fore leg.
    - 59b. Left view of third and fourth male rostral segments.
    - 59c. Enlarged view of left stridulatory comb.
60. *Anisops nasuta* Fieber.
    - 60a. Inner surface view of male left fore leg.
    - 60b. Enlarged view of left stridulatory comb.
61. *Anisops assimilis* White.
    - 61a. Inner surface view of male right fore leg minus the tarsus.
    - 61b. Left view of third and fourth male rostral segments.
    - 61c. Enlarged view of right stridulatory comb.
62. *Anisops decipiens* Hutchinson.
    - 62a. Inner surface view of male right fore leg minus the tarsus.
    - 62b. Enlarged view of right stridulatory comb.
    - 62c. Left view of third and fourth male rostral segments.
63. *Anisops thienemanni* Lundblad.
    - 63a. Inner surface view of male left fore leg.
    - 63b. Left view of third and fourth male rostral segments.
    - 63c. Enlarged view of left stridulatory comb.

PLATE XLVIII

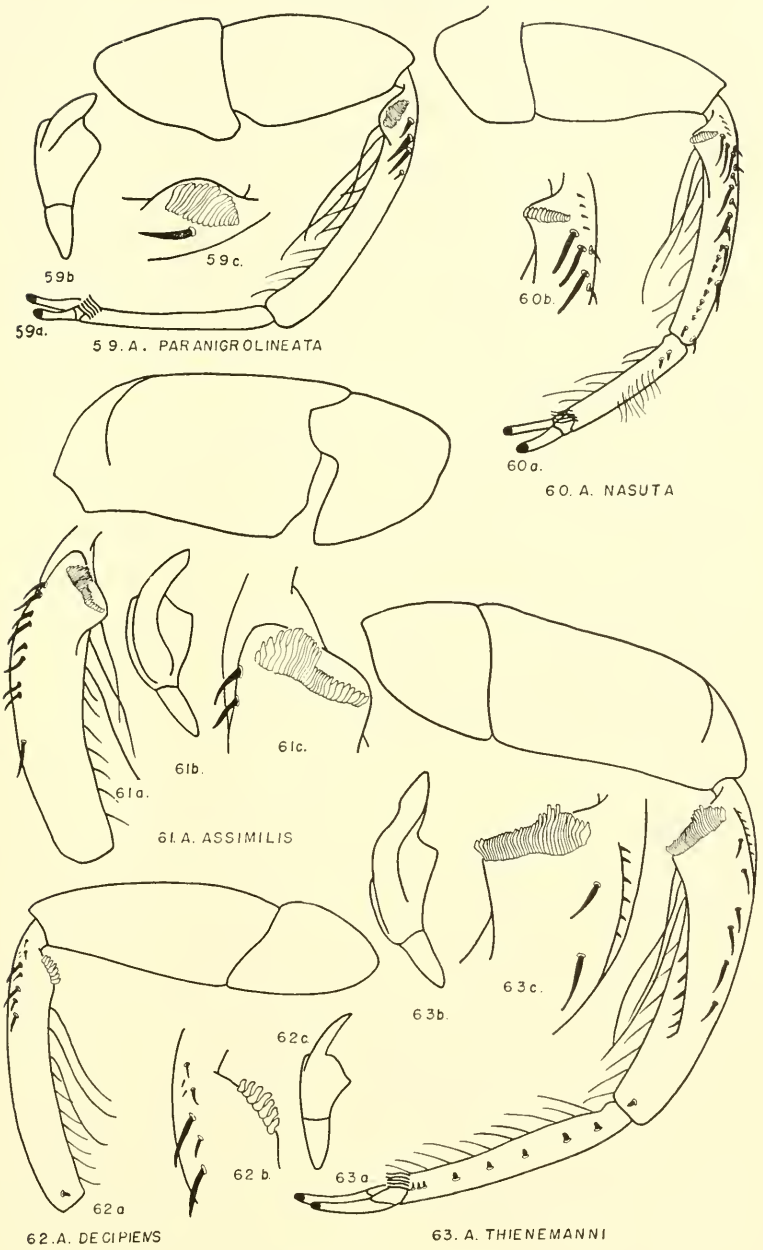


PLATE XLIX

FIGURE

64. *Anisops sardea* Herrich-Shaffer.
    64a. Inner surface view of male left fore leg.
    64b. Enlarged view of left stridulatory comb.
65. *Anisops bouvieri* Kirkaldy.
    65a. Inner surface view of male left fore leg.
    65b. Enlarged view of left stridulatory comb.
66. *Anisops extendofrons* n. sp.
    66a. Inner surface view of male left fore leg.
    66b. Left view of third and fourth male rostral segments.
    66c. Enlarged view of left stridulatory comb.
67. *Anisops madagascarensis* Poisson.
    67a. Inner surface view of male left fore leg.
    67b. Enlarged view of left stridulatory comb.

PLATE XLIX

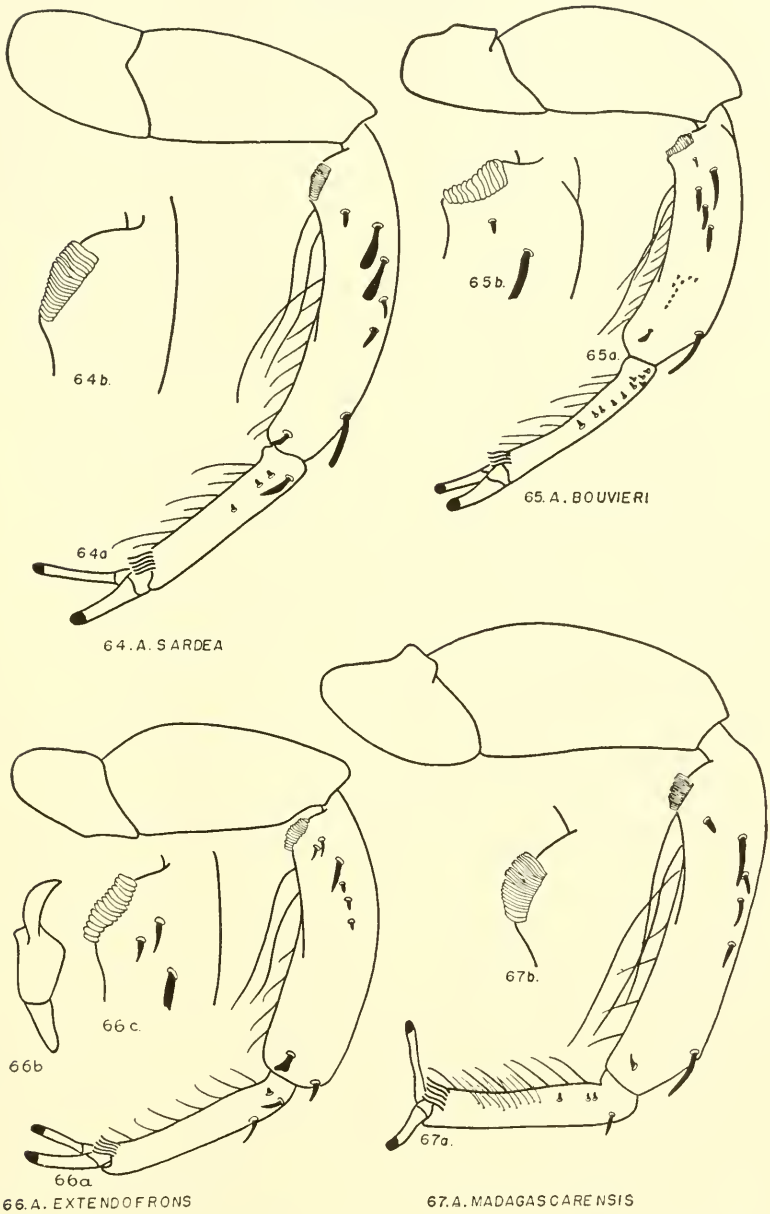

64b.
64a
64. A. SARDEA
65b.
65a
65. A. BOUVIERI
66c.
66b
66a
66. A. EXTENDOFRONS
67b.
67a.
67. A. MADAGASCARENSIS

PLATE L

FIGURE

68. *Anisops crinita* n. sp.
    - 68a. Inner surface view of male left fore leg.
    - 68b. Left view of third and fourth male rostral segments.
    - 68c. Enlarged view of left stridulatory comb.
69. *Anisops waltairensis* n. sp.
    - 69a. Inner surface view of male left fore leg.
    - 69b. Left view of third and fourth male rostral segments.
    - 69c. Enlarged view of left stridulatory comb.
70. *Anisops leesoniana* Hutchinson.
    - 70a. Inner surface view of male left fore leg.
    - 70b. Left view of third and fourth male rostral segments.
    - 70c. Enlarged view of left stridulatory comb.
71. *Anisops batillifrons* Lundblad.
    - 71a. Inner surface view of male left fore leg.
    - 71b. Enlarged view of left stridulatory comb.
72. *Anisops poweri* Hutchinson—Inner surface view of male left fore leg.
73. *Anisops cavifrons* n. sp.
    - 73a. Inner surface view of male left fore leg.
    - 73b. Left view of third and fourth male rostral segments.
    - 73c. Enlarged view of left stridulatory comb.

PLATE I

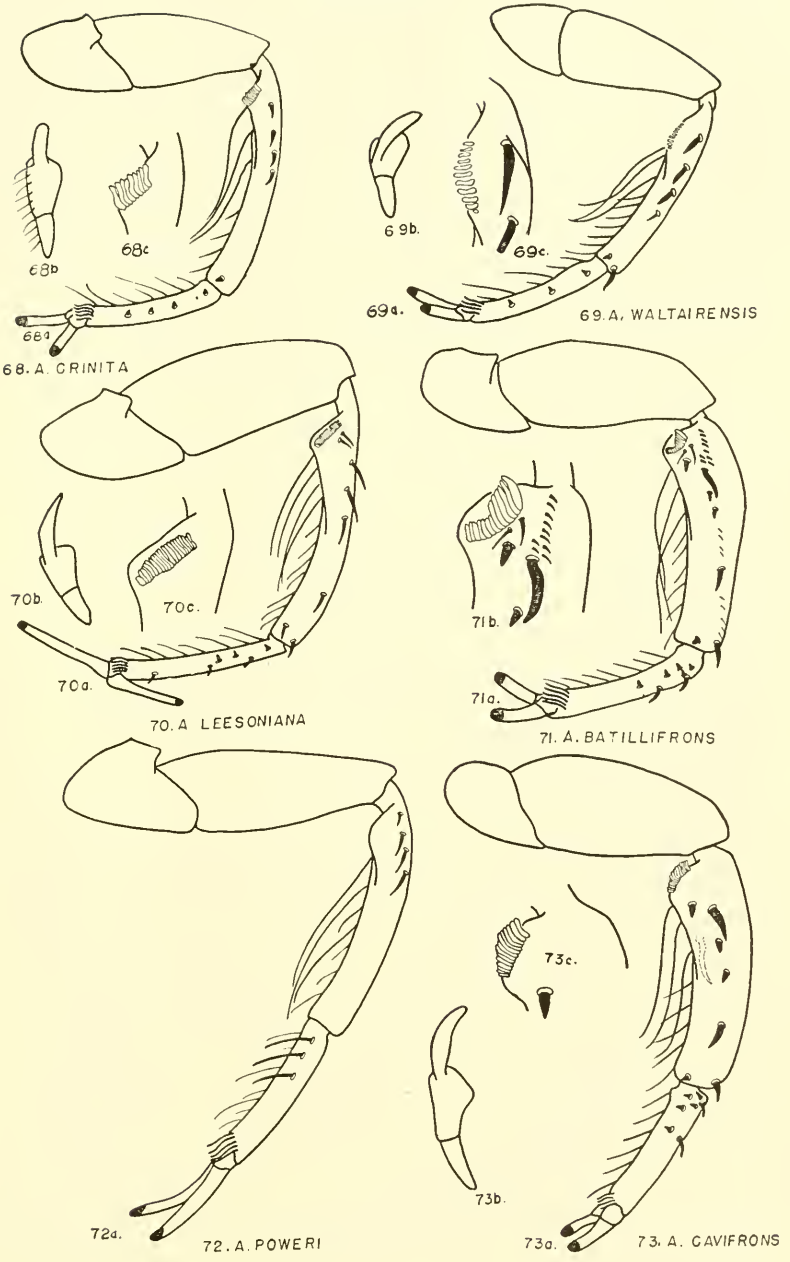

68b
68c
68a
68. A. CRINITA
69b.
69c.
69a.
69. A. WALTAIRENSIS
70b.
70c.
70a.
70. A LEESONIANA
71b.
71a.
71. A. BATILLIFRONS
72a.
72. A. POWERI
73c.
73b.
73a.
73. A. CAVIFRONS

PLATE LI

FIGURE

74. *Anisops gracilis* Hutchinson.
    74a. Inner surface view of male left fore leg.
    74b. Left view of third and fourth male rostral segments.
    74c. Enlarged view of left stridulatory comb.
75. *Anisops kempi* n. sp.
    75a. Inner surface view of male left fore leg.
    75b. Left view of male rostrum.
    75c. Enlarged view of left stridulatory comb.
76. *Anisops vitrea* Signoret.
    76a. Inner surface view of male left fore leg.
    76b. Left view of third and fourth male rostral segments.
    76c. Enlarged view of left stridulatory comb.
77. *Anisops exigera* Horvath.
    77a. Inner surface view of male left fore leg.
    77b. Left view of third and fourth male rostral segments.
    77c. Enlarged view of left stridulatory comb.
78. *Anisops breddeni* Kirkaldy.
    78a. Inner surface view of male left fore leg.
    78b. Enlarged view of left stridulatory comb.
79. *Anisops graciloides* n. sp.
    79a. Inner surface view of male left fore leg.
    79b. Left view of third and fourth male rostral segments.
    79c. Enlarged view of left stridulatory comb.

PLATE LI

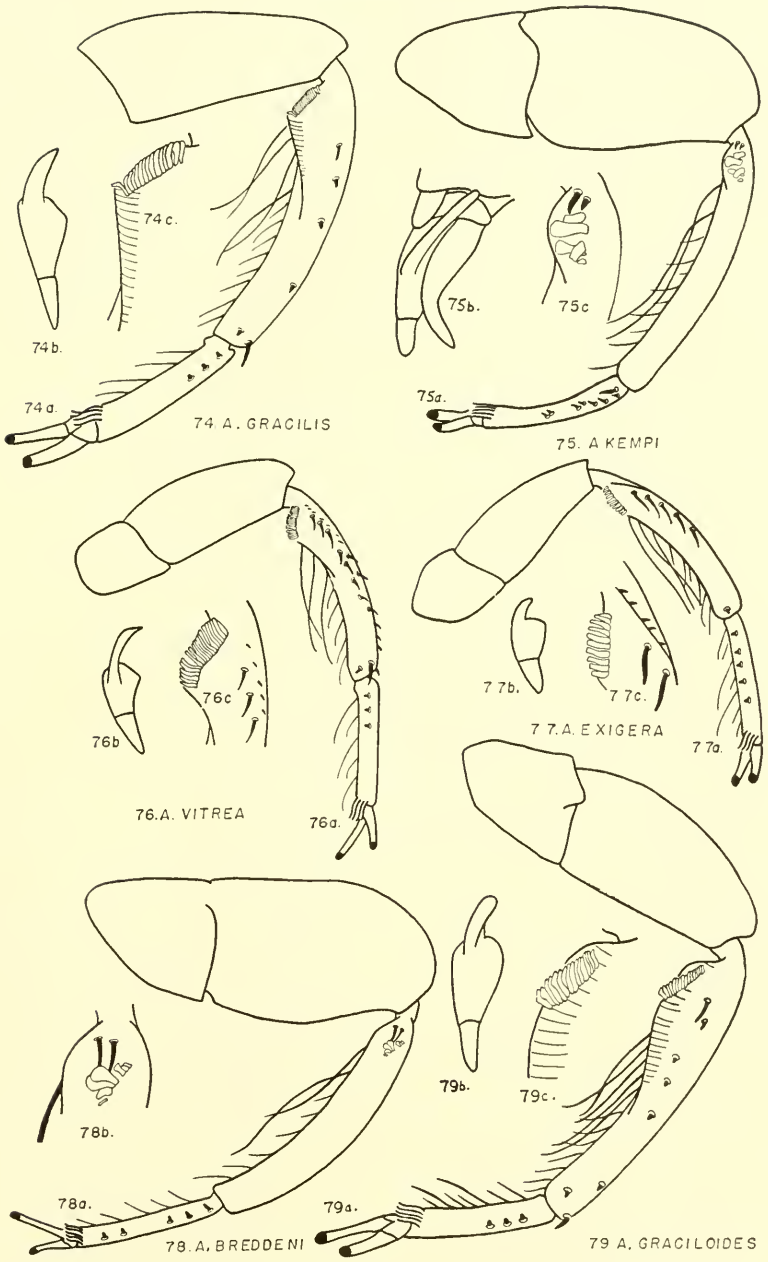

74c.
74b.
74a.
74 A. GRACILIS
75b.
75c
75a.
75. A KEMPI
76c
76b
76.A. VITREA
76a.
77b.
77c.
77.A. EXIGERA
77a.
78b.
78a.
78. A. BREDDENI
79b.
79c.
79a.
79 A. GRACILOIDES

PLATE LII

FIGURE

80. *Anisops debilis* Gerstaecker.
    - 80a. Inner surface view of male left fore leg.
    - 80b. Left view of third and fourth male rostral segments.
    - 80c. Enlarged view of left stridulatory comb.
81. *Anisops rigoensis* n. sp.
    - 81a. Inner surface view of male left fore leg.
    - 81b. Left view of third and fourth male rostral segments.
    - 81c. Enlarged view of left stridulatory comb.
82. *Anisops hypatia* Hutchinson.
    - 82a. Inner surface view of male left fore leg.
    - 82b. Left view of third and fourth male rostral segments.
    - 82c. Enlarged view of left stridulatory comb.
83. *Anisops majiensis* n. sp.
    - 83a. Inner surface view of male left fore leg.
    - 83b. Left view of third and fourth male rostral segments.
    - 83c. Enlarged view of left stridulatory comb.
84. *Anisops balcis* Hutchinson.
    - 84a. Inner surface view of male left fore leg.
    - 84b. Enlarged view of left stridulatory comb.

PLATE LII

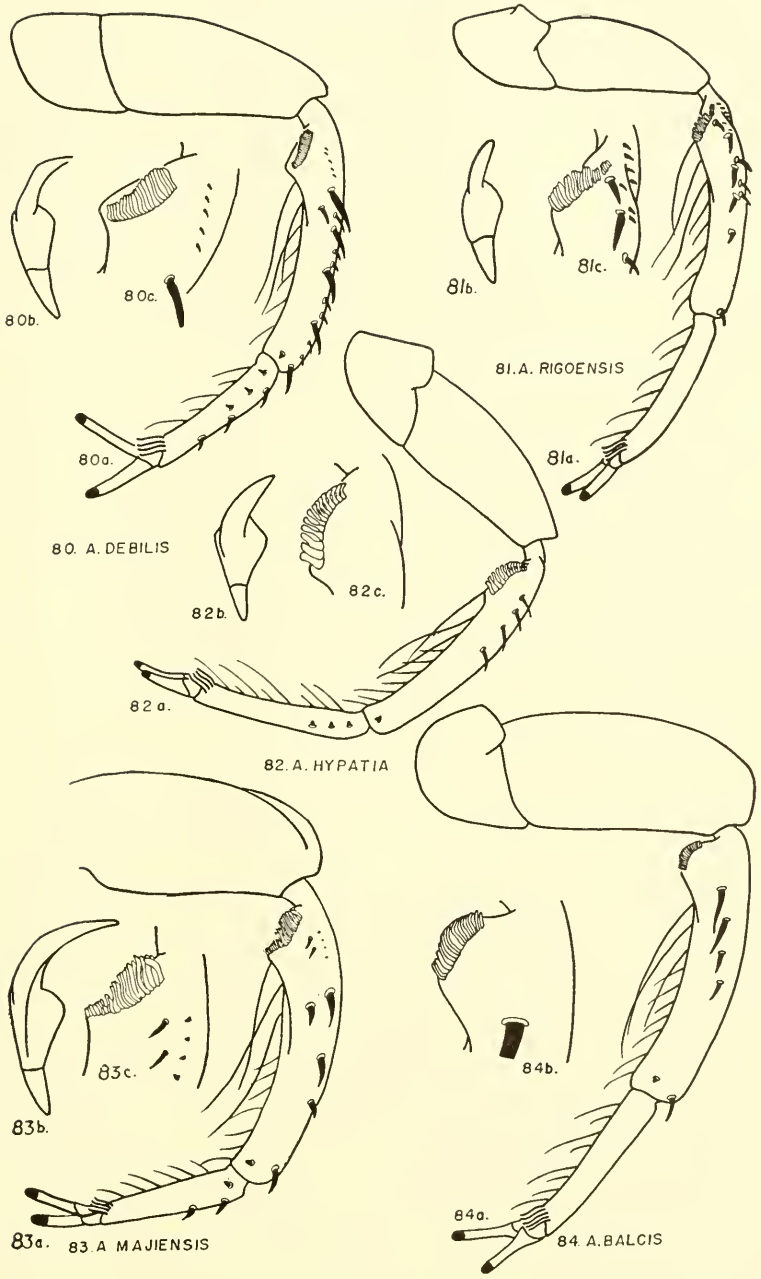
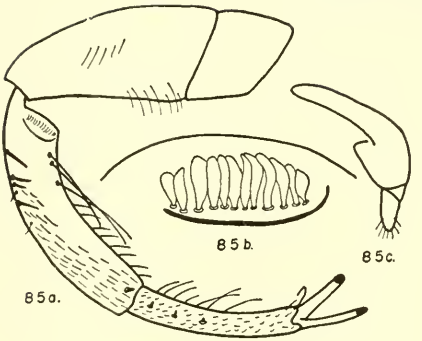

80b.
80c.
80a.
80. A. DEBILIS
81b.
81c.
81. A. RIGOENSIS
81a.
82b.
82c.
82a.
82. A. HYPATIA
83c.
83b.
83a.
83. A MAJIENSIS
84b.
84a.
84. A. BALCIS

PLATE LIII

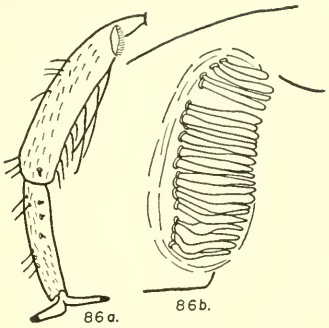
FIGURE

85. *Anisops alluaudi* Poisson.
    - 85a. Inner surface view of male right fore leg.
    - 85b. Enlarged view of right stridulatory comb.
    - 85c. Right view of third and fourth male rostral segments.
86. *Anisops mauricensis* Poisson.
    - 86a. Inner surface view of male right fore tibia and tarsus.
    - 86b. Enlarged view of right stridulatory comb.
87. *Anisops lanceolata* Poisson.
    - 87a. Inner surface view of male right fore leg.
    - 87b. Diagramatic frontal view of third male rostral segment.
    - 87c. Enlarged view of right stridulatory comb.
88. *Anisops letitia* Hutchinson—inner surface view of right fore tibia.
89. *Anisops meulenaeri* Poisson.
    - 89a. Inner surface view of right male fore femur.
    - 89b. Inner surface view of right male fore tibia.
    - 89c. Inner surface view of right male fore tarsus.
    - 89d. Enlarged view of right stridulatory comb.
    - 89e. Right view of third and fourth male rostral segments.

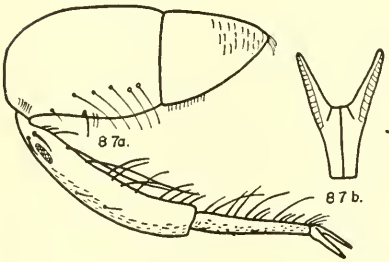
PLATE LIII

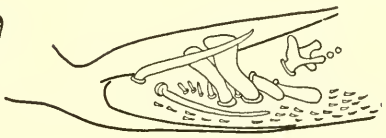


85. A. ALLUAUDI

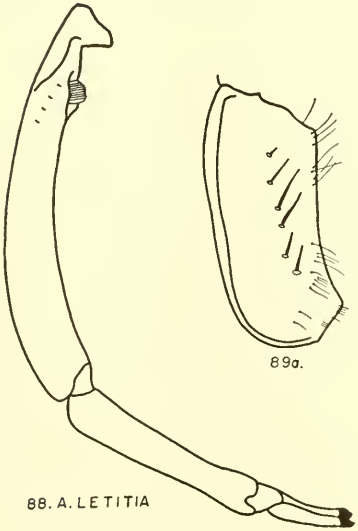


86. A MAURICENSIS

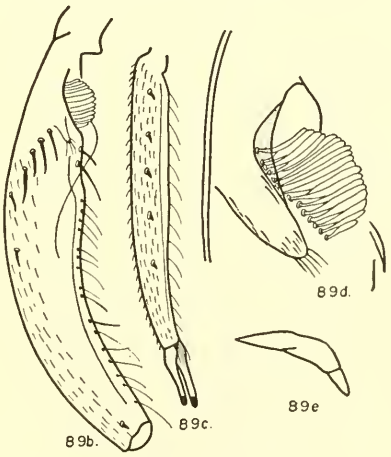




87. A. LANCEOLATA



88. A. LETITIA



89. A. MEULENAEREI

PLATE LIV

FIGURE

90. *Anisops milloti* Poisson.
    90a. Inner surface view of male right fore leg.
    90b. Enlarged view of right stridulatory comb.
    90c. Right view of male head.
91. *Anisops worthingtoni* Jaczewski.
    91a. Inner surface view of male left fore tibia and tarsus.
    91b. Left view of male head.
92. *Anisops pugnax* Poisson.
    92a. Enlarged view of left stridulatory comb.
    92b. Inner surface view of left male fore tibia and tarsus.
93. *Anisops nivea* (Fabricius)—left view of male head and pronotum.
94. *Anisops edepol* Kirkaldy—left view of male head and pronotum.
95. *Anisops poweri* Hutchinson—left view of male head and pronotum.

PLATE LIV

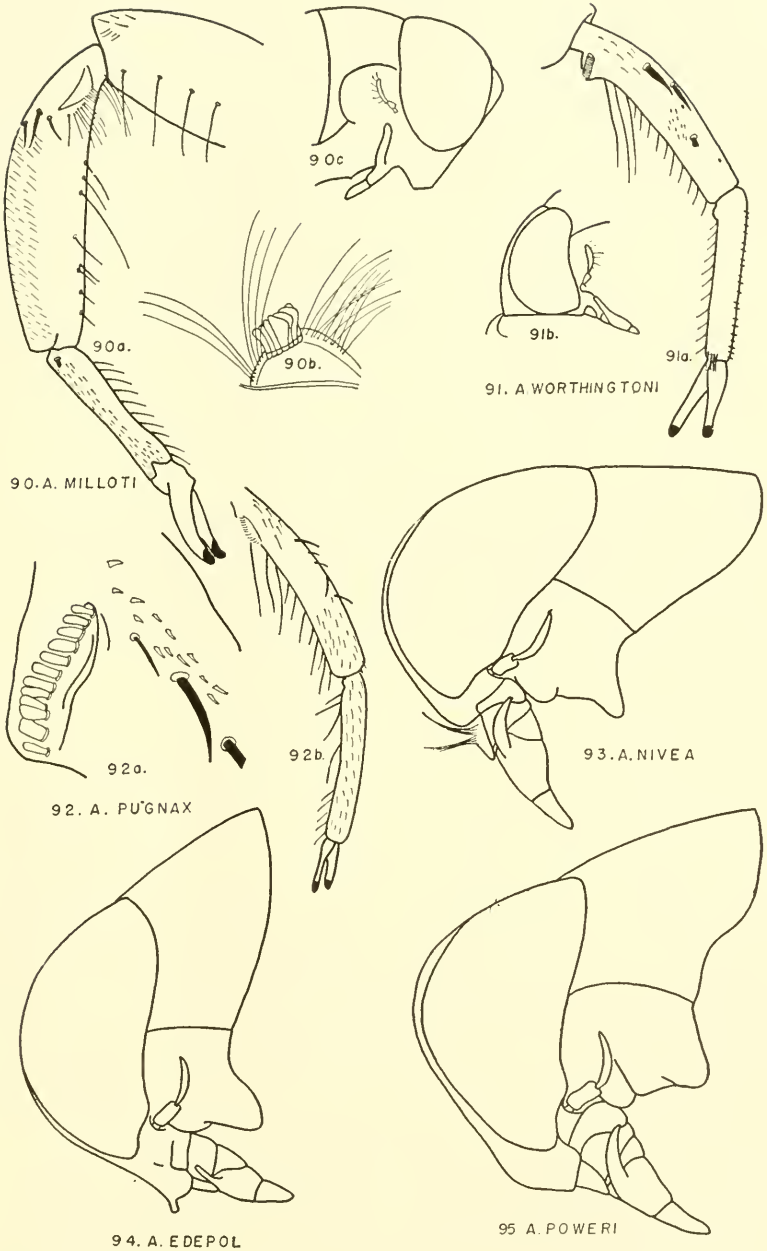

90c
90a.
90b.
90. A. MILLOTI
91b.
91a.
91. A. WORTHINGTONI
92a.
92b
92. A. PUGNAX
93. A. NIVEA
94. A. EDEPOL
95 A. POWERI

PLATE LV

FIGURE

96. *Anisops hancocki* Hutchinson—left view of male head and pronotum.
97. *Anisops balcis* Hutchinson—left view of male head and pronotum.
98. *Anisops nasuta* Fieber—left view of male head and pronotum.
99. *Anisops breddeni* Kirkaldy—left view of male head and pronotum.
100. *Anisops bouvieri* Kirkaldy—left view of male head and pronotum.

PLATE LV

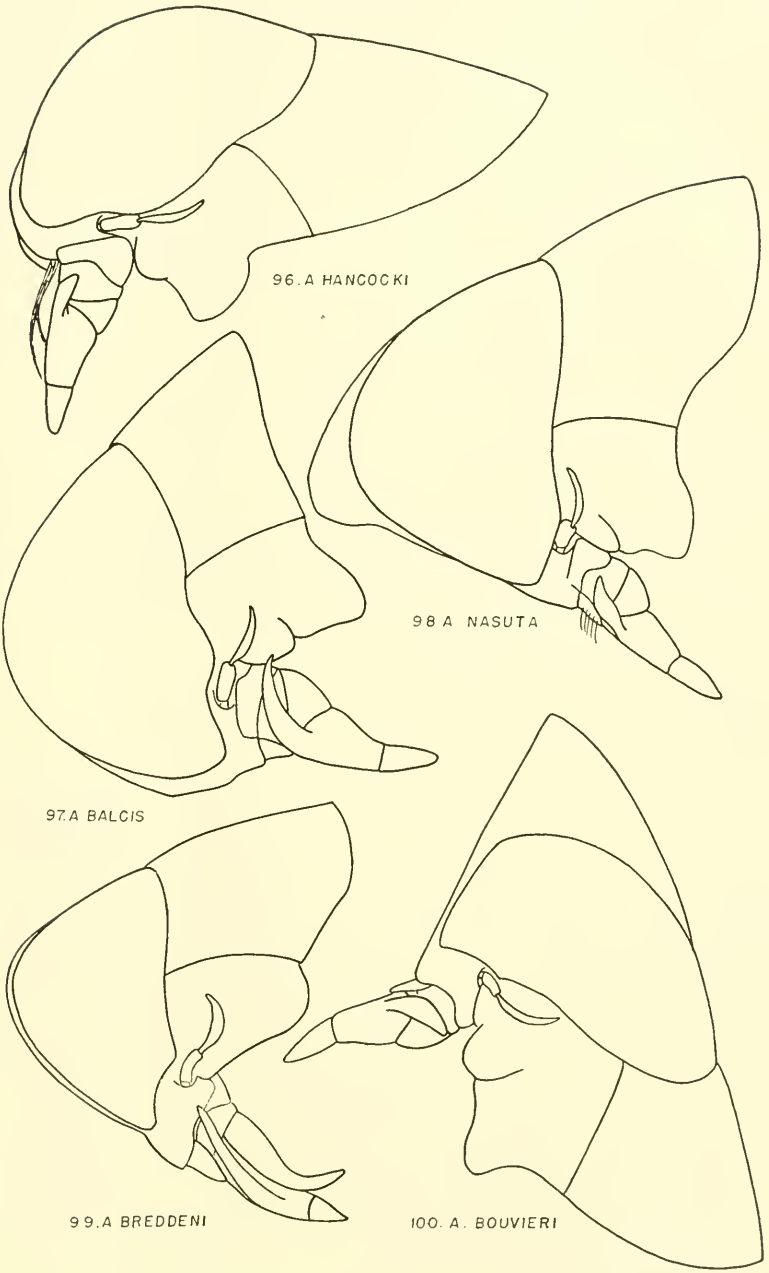

96. A HANCOCKI
98 A NASUTA
97. A BALCIS
99. A BREDDENI
100. A. BOUVIERI

PLATE LVI

FIGURE

101. *Anisops batillifrons* Lundblad—left view of male head and pronotum.
102. *Anisops sardea* Herrich-Shaffer—left view of male head and pronotum.
103. *Anisops sikoroensis* n. sp.—left view of male head and pronotum.

PLATE LVI

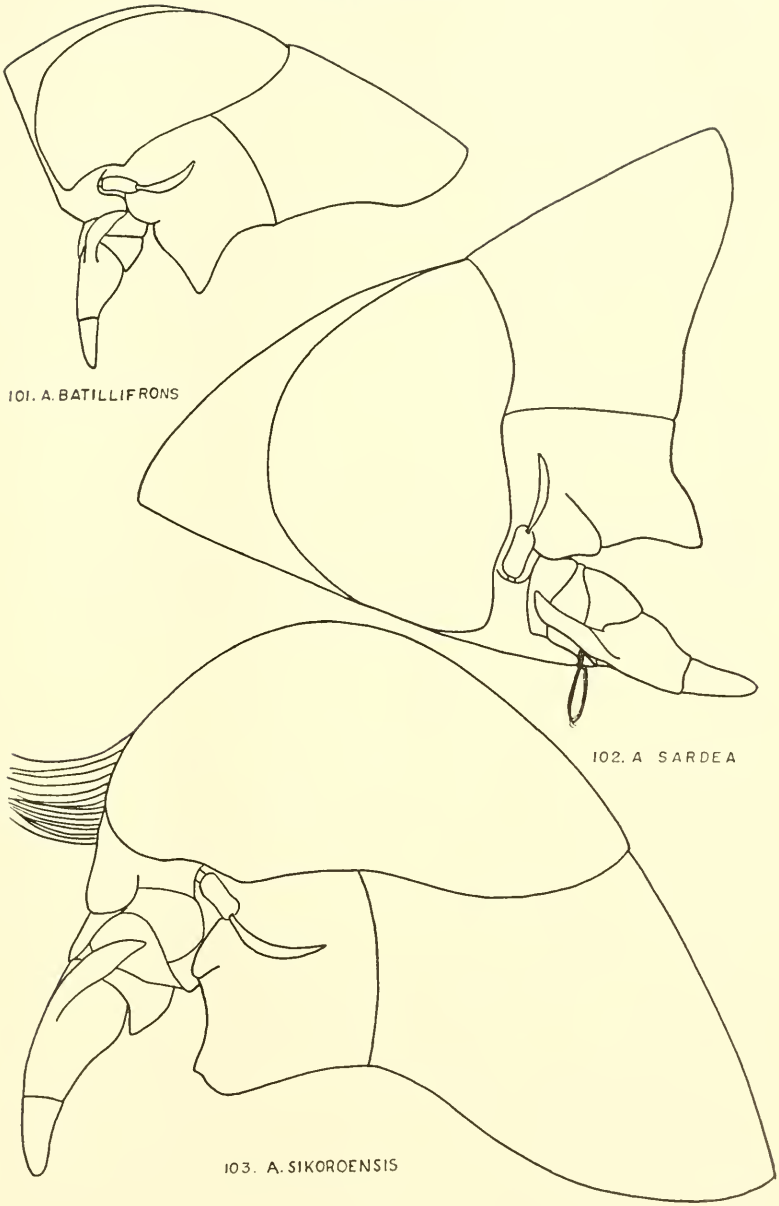
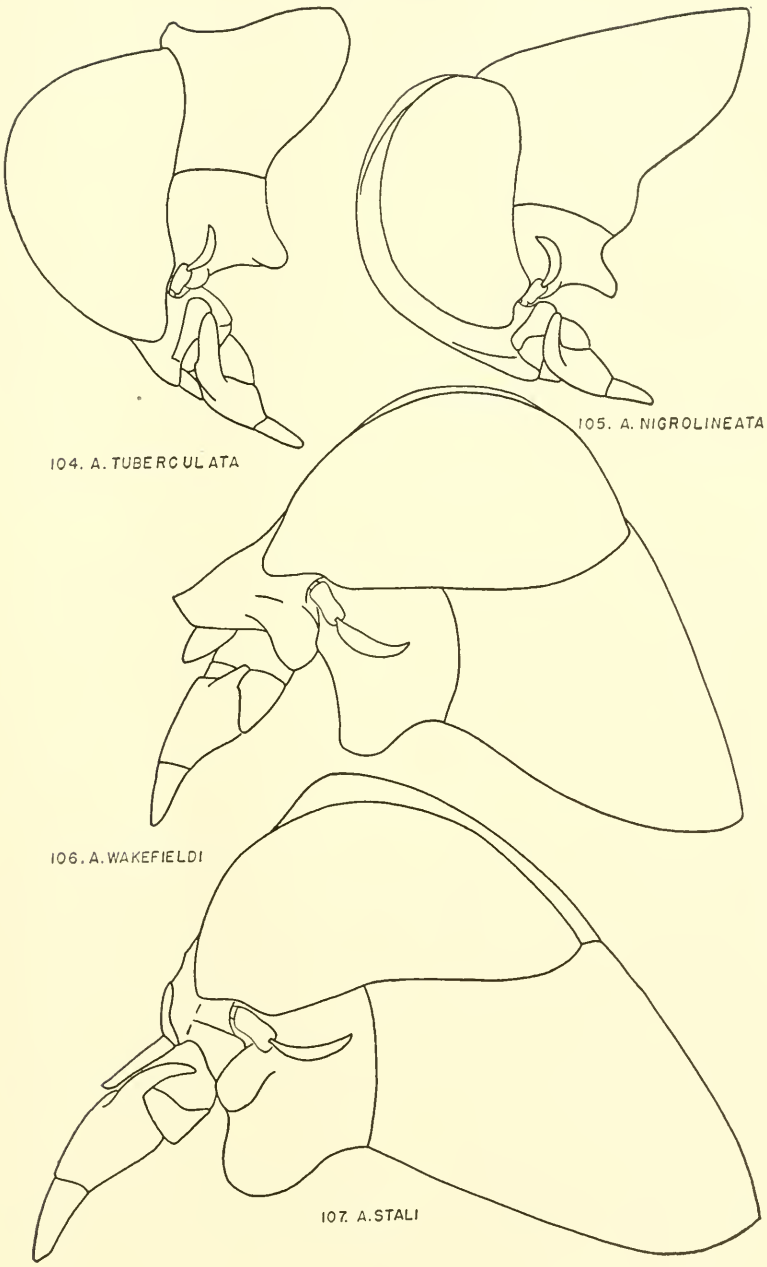


PLATE LVII

FIGURE

104. *Anisops tuberculata* Poisson—left view of male head and pronotum.
105. *Anisops nigrolineata* Lundblad—left view of male head and pronotum.
106. *Anisops wakefieldi* White—left view of male head and pronotum.
107. *Anisops stali* Kirkaldy—left view of male head and pronotum.

PLATE LVII


104. A. TUBERCULATA
105. A. NIGROLINEATA
106. A. WAKEFIELDI
107. A. STALI

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Concerning Oligocene Amphisbaenid Reptiles

BY

EDWARD H. TAYLOR

ABSTRACT: The paper deals with the amphisbaenid fauna of the Orellan, Middle Oligocene of Logan County, Colorado, and with a single species from the Orellan of Converse County, Wyoming. The following species are described: *Hyporhina galbreathi sp. nov., Rhineura anblyceps sp. nov., Rhineura hibbardi sp. nov., Rhineura wilsoni sp. nov., Gilmoreia attenuatus gen. et sp. nov.* The family Hyporhinidae is recognized for the genus *Hyporhina,* and the family Crythiosauridae is proposed for a Mongolian genus *Crythiosaurus.*

INTRODUCTION

The amphisbaenid reptiles have been variously treated by previous authors. They have been regarded as a Family, as a Superfamily, and as an Infraorder under the Lacertilia (Sauria); as a Suborder of equal rank with the Sauria, and even as a reptilian Order. Some authors have placed all the known species in a single family, the Amphisbaenidae; while others have found it convenient to recognize several families. More than 30 genera have been named.

This aberrant group of vertebrates appears to stand, in relation to the other living Reptilia, much as do the Gymnophiona to other living Amphibia; and it is doubtful that the differences from Caudata or other Amphibia displayed by the Gymnophiona are more significant than those that obtain between the Amphisbaenia and the other groups of the Reptilia. I am strongly inclined toward a recognition of these considerable differences by placing them in an Order of their own. A discussion of the matter is, however, not the primary concern of this paper. Romer (1932) considers them of Subordinal rank, as do Smith and Taylor (1950). These authors are followed here.

There is considerable difference of opinion as to the validity of many of the genera proposed for the living species, and the number recognized varies much with different authors. Loveridge (1940)

has recently reviewed the African genera, recognizing *Trogonophis, Pachycalamus, Agamodon, Baikia, Blanus, Amphisbaena, Placogaster, Geocalamus, Monopeltis* and *Dalophia.** Laurent has recently revived two genera *Chirindia* and *Cynisca* placed by Loveridge in the genus *Amphisbaena.* He describes a new genus *Tomuropeltis,* thus bringing the total African genera to 13.

The American genera *Bipes,* Mexico, *Rhineura,* Florida and Oligocene of Colorado, etc., *Lepisternon* Brazil, *Bronia* Brazil, *Aulura,* Brazil, *Anopsibaena,* Brazil, *Mesobaena,* Venezuela, *Diphalus,* Virgin Islands, *Cadea,* Cuba, are probably all recognizable genera. However, the generic names *Chirotes, Hemichirotes, Euchirotes* and *Bimanus* of Mexico should doubtless be treated as synonyms of *Bipes.* I am uncertain as to the status of *Aporarchus, Sarea, Monotrophis Cephalopeltis* and *Ancylocranium.*

Four genera known only from fossils are recognized. These are *Hyporhina, Ototriton, Crythiosaurus* and *Gilmoreia* (the latter herein described).

The question of the number of living families in the amphisbaenids is likewise unsettled. I regard the families Amphisbaenidae, Bipedidae and Trogonophidae (for the acrodont group) as valid. It is not impossible that certain other groups of species merit family status. All of the previously known American fossil forms except *Hyporhina* are presumably referable to the Amphisbaenidae. I consider *Hyporhina* worthy of family rank under the name Hyporhinidae based primarily on the presence of the postorbital bone. While the anatomy of the Mongolian genus *Crythiosaurus* is not wholly known, the characters given seem to warrant the erection of the family Crythiosauridae, the characters being those of the genus.

It is possible that *Ototriton* belongs to still another family. Camp, Taylor and Welles (1942) placed *Ototriton* in the Dolichosauridae and *Lestophis* (the latter known only from vertebrae) in the Sauria.

The Amphisbaenia represent a group of vertebrates that now have become highly specialized for subterranean life by total or partial loss of limbs, and the aquisition of a serpentine form. Because of this they have survived long after the extinction of their more generalized terrestrial tetrapod ancestors. One may conceive of a populous tetrapod suborder (or order) existing in the past, and practically worldwide in distribution, that had diversified into several families. Competition for food, probably among terrestrial

* The listing of the genus *Dalophis* (Loveridge 1941, p. 357) for *Dalophis jallae* and *Dalophis pistillum* is an error. These are properly *Dalophia,* and are so treated elsewhere.

members of the same order, forced certain forms in several families to seek underground food. It is presumed that later the terrestrial generalized forms succumbed to competition with members of other orders.

Counterparts of these happenings are suggested in the Order Gymnophiona of the Class Amphibia. Here only the limbless burrowing forms have survived. In the Order Caudata, members of certain suborders have survived probably because of their subterranean habitat (Suborder Meantes). In other suborders certain of the less specialized forms still exist. In the Mutabilia a few species have become subterranean, while many of the families retain the generalized terrestrial tetrapod form.

Similar surviving groups occur in the Sauria. The families Anelytropidae, Feylinidae, Dibamidae, Anniellidae, and Pygopodidae all are regarded as burrowing survivors of former terrestrial groups in which only relict forms are now known. In the following families only a part of the members have taken on a serpentine form and become subterranean: Scincidae (*Brachymeles* and several other genera), Zonuridae (*Chamaesaura*), Anguidae (*Ophisaurus*), and Tejiidae (*Scolecosaurus*). In certain other genera this process of specialization is already begun.

Certain characters in which Amphisbaenia differ completely (or partly) from Sauria are:

1. Mode of progression (progression is made largely in a straight line by slight vertical undulations).
2. Loss or reduction of the right lung, rather than the left.
3. Absence of evidence in the skull of a pineal* or parietal eye.
4. Absence of skull arches.
5. Annulation of body.
6. Absence of most of the dermal bones of the orbital ring.
7. Overlapping (telescoping) of bones.
8. Phalangeal formula when present 3-3-3-3-3 instead of the more typical 2-3-4-5-3.
9. A greater development of chondral elements in the skull.

The known fossil history of the Amphisbaenia on the North American continent begins with the discovery of *Ototriton solidus* Loomis in the early Eocene (Wasatchian). Even in the Eocene it would appear that the group had already undergone a long evolution. *Ototriton solidus* is one of the largest species of the group judging by the skull that measures 31.5 mm. in length and 23.5 mm. in

* Reported as present by Gilmore and Jepsen (1945); said to be absent by Zangerl (1944). I suspect that the opening on the median line between the supraoccipitals and parietal of *Hyporhina* should not be interpreted as that of a pineal eye.

width, a size that is reached by only a few species living today. It already displays most of the expected characteristics of amphisbaenids, as well as its own peculiar specializations. Another species *Ototriton minor* is about half as large. Two other forms from the Middle Eocene, based on vertebrae alone, have been referred to the genus *Lestophis,* a genus of doubtful status.

Passing over the Upper Eocene where specimens are as yet unknown, we find several species and genera present in the Oligocene. Above the Oligocene another great gap in our knowledge occurs, and no specimen is known from the Miocene, the Pliocene, or the Pleistocene. In the Recent however five living forms, belonging to two genera, *Rhineura* and *Bipes,* are known on the North American continent and one other genus, *Amphisbaena,* with four or more species, occurs in the West Indies. Thus the probability is strong that Amphisbaenids were present and will eventually be found as fossils in the three periods that have as yet no known species.

Some time ago three Amphisbaenid specimens in the paleontological section of the University of Kansas Museum of Natural History were placed in my hands for study by Dr. R. W. Wilson, Associate Curator of Paleontology, University of Kansas, and Mr. Edwin C. Galbreath of that Institution. These specimens were found in the summer of 1946 by a party consisting of Richard Rinker, Joao Moojen, Edwin C. Galbreath, Theodore Downs, Russell R. Camp, and Henry Hildebrand, under the direction of Dr. Claude W. Hibbard, while investigating Oligocene faunas of Logan County, Colorado. The three specimens represent the first† reported finds of amphisbaenids in the Oreodon Zone of Logan County, Colorado. A number of other remains taken at the same time pertain to reptiles of other groups and these are to be reported at a later time.

Through the courtesy of the authorities of the University of Colorado Museum, I have obtained a loan of an amphisbaenid skull collected by Dr. R. W. Wilson in 1940 at the same locality as those collected by the University of Kansas party in 1946.

Through the courtesy of Dr. Lewis B. Kellum and Dr. Claude Hibbard of the University of Michigan Museum of Paleontology, I have had available for study three Amphisbaenid skulls from Logan County, collected by Dr. Hibbard and party in 1948. A single specimen of an Amphisbaenid skull from the Oligocene of Wyoming was loaned by Dr. C. Lewis Gazin of the U. S. National Museum.

† One specimen consisting of a vertebra taken in 1873 from the Horsetail Creek Beds (Titanotherium Beds, Horizon A) of Logan County, was described by E. D. Cope as *Platyrachis coloradoensis.* Cope did not recognize the relationship of the specimen to the amphisbaenids and it remained for Gilmore (1928) to transfer the form to the genus *Rhineura.*

Mr. Galbreath in 1948 acquired four other skulls in the Logan County area which he presented to the University of Kansas. These also have been available for study.

I am of the opinion that certain of the specimens represent undescribed species. One of these is being placed in the genus *Hyporhina* Baur and certain ones are being placed in the genus *Rhineura*. One is regarded as representing a new genus.

Of the genus *Rhineura,* aside from a living species in peninsular Florida, four fossils forms are recognized: these are *Rhineura hatcheri* Baur, *Rhineura minuta* Gilmore, *Rhineura sternbergii* Walker, all based on adequate material. A fifth species *Rhineura coloradoensis* (Cope) (based on *Platyrachis coloradoensis* Cope) may be regarded as being of uncertain status; and until its vertebrae are found associated with a skull, its relationship to the species here described cannot be ascertained.

The following outline presents data on the geological and geographical distribution of North American amphisbaenids.

KNOWN GEOLOGICAL DISTRIBUTION OF THE AMPHISBAENIA IN CONTINENTAL NORTH AMERICA

Recent (Living forms)*			*Rhineura floridana* (Baird), *Bipes biporus* (Cope), Baja Calif, Mex. *Bipes canaliculatus* (Bonneterre), Guerrero, Mex. *Bipes tridactylus* (Dugès), Guerrero, Mex. *?Bipes sp.* Arizona
Pleistocene (Unknown)			
Pliocene (Unknown)			
Miocene (Unknown)			
Oligocene	Late.	Whitneyan, Upper Brule (Leptauchenia Zone)	*Rhineura hatcheri* Baur *Hyporhina antiqua* Baur
	Middle.	Orellan, Lower Brule (Oreodon Zone)	*Rhineura sternbergii* Walker *Rhineura minuta* Gilmore *Rhineura hibbardi sp. nov.* *Rhineura wilsoni sp. nov.* *Rhineura amblyceps sp. nov.* *Rhineura hatcheri* Baur *Hyporhina galbreathi sp. nov.* *Gilmoreia attenuatus sp. nov.*
	Early.	Chadronian (Titanotherium Zone)	*Rhineura coloradoensis* (Cope)

* These species were originally described as *Lepidosternon floridana, Bipes canaliculatus, Euchirotes biporus* and *Hemichirotes tridactylum.* Another species probably occurs. (see James in Long's Expedition to the Rocky Mountains, vol. 1, 1823, p. 484; Taylor, Copeia, 1938, no. 4, Dec. 10, p. 202.)

Eocene	Late. (Unknown)		
	Middle.	Bridgerian, Bridger, Black's Fork member	*Lestophis anceps* (Marsh) Uinta Co., Wyo. *Lestophis crassus* (Marsh) Uinta Co., Wyo.
		Wasatchian, Wind River, Lost Cabin member	*Ototriton minor* Gilmore and Jepsen, Natrona Co., Wyo.
	Early.		
		Wasatchian, Wind River, Lysite member	*Ototriton solidus* Loomis, Fremont Co., Wyo.

GEOGRAPHICAL DISTRIBUTION OF OLIGOCENE AMPHISBAENIDAE

Whitneyan (Leptauchenia Zone)	Battle Draw Springs, Washington Co., S. D.	*Rhineura hatcheri* Baur *Hyporhina antiqua* Baur
Orellan (Oredon Zone)	Sioux Co., Neb.	*Rhineura hatcheri* Baur
	Washington Co., S. D.	*Rhineura hatcheri* Baur
	Douglas, Converse Co., Wyo.	*Rhineura sternbergii* Walker *Rhineura minuta* Gilmore *Gilmoreia attenuatus sp. nov.*
	Logan Co., Colo.	*Hyporhina galbreathi sp. nov.* *Rhineura hibbardi sp. nov.* *Rhineura amblyceps sp. nov.* *Rhineura wilsoni sp. nov.* *Rhineura hatcheri* Baur
Chadronian (Titanotherium Zone)	Logan Co., Colo.	*Rhineura coloradoensis* Cope

In the preparation of this paper I am under deep obligation to Dr. Robert Wilson and Mr. Edwin Galbreath for assistance with the stratigraphic nomenclature, and for reading and criticizing the manuscript.

Dr. Byron Leonard has kindly prepared the photographs of the skulls reproduced here. For this I am indeed grateful.

SYSTEMATIC TREATMENT

A total of fourteen skulls have been available in this study. They vary considerably in completeness and state of preservation. All but one of these are from the Orellan (Oreodon Zone) of Logan County, Colorado. This single species is from the Orellan of Converse County, Wyoming, likewise the type locality of *Rhineura*

minuta and *Rhineura sternbergii,* and is here described as a new genus and species.

KEY TO SYMBOLS USED IN THE TEXT FIGURES

BO	Basioccipital
BS	Basiphenoid
C	Coronoid
CB	Corpora bigemina
CH	Cerebral hemisphere
D	Dentary
EC	Extracolumella
EO	Exoccipital
EP	Epipterygoid
F	Frontal
FM	Foramen magnum
FO	Fenestra ovale
M	Maxillary
N	Nasal
O	Orbit
OCO	Occipital condyle
OLL	Olfactory lobe
OS	Orbitosphenoid
OT	Otic
P	Parietal
PA(L)	Palatine
PF	Prefrontal
PM	Premaxilla
PO	Paroccipital (in *Rhineura*)
PO	Postorbital (in *Hyporhina*)
PT	Pterygoid
PV(V)	Prevomer
Q	Quadrate
S	Stapes
SA	Surangular (Supraangular)
SCC	Semicircular canal
SO	Supraoccipital
SQ	Squamosal

GILMOREIA *genus novum*

A genus of fossil Amphisbaenid reptile characterized by a shallow or absent orbital vacuity, not overhung by the frontal bone; elevated portion of skull much narrowed, its surface smooth, lacking sculpture. Section of skull posterior to its highest point much shortened; no postfrontal; dental characters unknown. Type species *Gilmoreia attenuatus.*

Gilmoreia attenuatus sp. nov.

Plate LVIII, figs. 3, 4, 5; text fig. 1, a, b, c.

Type.—United States National Museum, No. 16308 (field No. 40), consisting of a skull, the anterior part, from about the middle of the frontals, missing. The quadrate, extracolumella, pterygoid, palatine, prevomer, and entire lower jaw missing.

Type locality.—Eight miles east of Douglas, Converse County, Wyoming. G. F. Sternberg, collector, 1931.

Horizon.—Oligocene, Brule.

Diagnosis.—The deflected portion of the skull is much longer than the remainder. The length from the anterior edge of the foramen magnum to the highest elevation of the skull is less than the median length of deflected portion of the parietal. The skull is attenuated anteriorly, its narrowest width being considerably anterior, not posterior, to the point of highest elevation. The diamenter of the brain cavity at the anterior level of the basioccipito-sphenoid

bone, is proportionally much larger than in *Hyporhina* or *Rhineura*. The outline of the squamosal is completely obliterated, the point of articulation for the quadrate, however, strongly projecting. The bones of the facial portion of the skull lacking sculpturing.

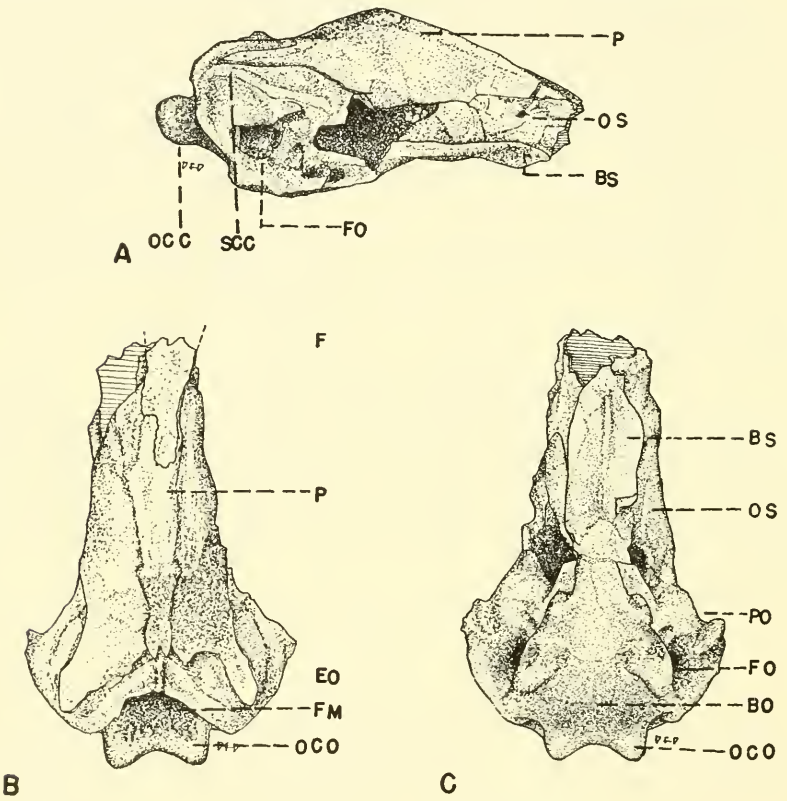

FIG. 1. *Gilmoreia attenuatus gen. et sp. nov.* Type, U. S. Nat. Mus. No. 16308 (original No. 40). Oligocene, Orellan (Brule), 8 m. N Douglas, Converse Co., Wyoming. G. F. Sternberg, collector, 1931. A. Lateral view; B. Dorsal view; C. Ventral view. Actual length of fossil 7.5 mm.

Description of type.—The greatest width of the moderately inflated posterior part of the otic region of the skull (4.5 mm.) is slightly greater than the length of the skull from the posterior edge of the condyles to the level of the highest point (4.25 mm.); the foramen magnum opens dorsally or, perhaps better, postero-dorsally.

The frontal bones are largely missing; their posterior ends, partially separated by a tongue from the parietal, are narrow, their

length nearly twice their width. The width of the frontal at the farthest (lateral) extension of the parietal is about 1.1 mm. It is presumed that this point is posterior to the middle of the total length of the frontal and that there is a very slight widening on the anterior terminal portions of the skull as is typical of certain living genera (*Amphisbaena, Bipes*).

The parietal is large, somewhat saddle-shaped and covers the greater part of the posterior dorsal surface of the skull, overlapping very considerably the deeper bones of the posterior part of the brain case, leaving only a very narrow rim of the supraoccipital and the posterior parts of the otic region bordering the foramen magnum. The foramen magnum tends to notch the parietal, the posterior parts appearing as two broadly rounded lobes. On the median line a short sagittal ridge arises from the main bone, projects back to dovetail on the median line with a very narrow median crest of the supraoccipital. The parietal also covers the greater portion of the lateral surface of the brain case terminating anteriorly in a point. This forward extension is visible along the elevated dorsal surface as a very narrow line, bordering the outer edge of the frontal (broken away on left side).

The supraoccipital, exoccipital, basioccipitals, and the otic capsule are fused into a single element, the former sutures now being completely obliterated. In the otic regions the two dorsal semicircular canals of the ear are clearly visible as two slightly elevated whitish ridges which meet nearly at a right angle at a point lateral to the foramen magnum where it is widest. The third canal is partly indicated on the posterior face of the skull.

The fenestra ovale is irregularly oval, and the stapes is present on the left side, though sunken more deeply than is normal. The columellar part is largely missing, only the basal portion remaining.

Overhanging the anterior edge of the fenestra ovale is the facet for the articulation of the quadrate. Presumably the squamosal is completely fused with the outer part of the otic region. In most cases the fusions in the skull are of chondral bone to chondral bone; here it would appear that the fusion is of dermal bone to chondral bone if the squamosal has even been present.

A short distance in front of the fenestra ovale is the longitudinally oval opening along the side of the brain case characteristic of the amphisbaenids, having an area exceeding that of the fenestra ovale; its upper posterior border is formed by the fused prootic. Beginning near the middle of the upper border is the orbitosphenoid that runs

forward forming a suture with the basal part of the brain case, the fused basisphenoid (parasphenoid). The anterior extension of the orbitosphenoid is broken away. A small foramen is evident in the bone and two canals can be discerned radiating from it. It would appear that the orbital vacuity is absent or if present is very shallow and has been moved far forward in comparison with that of *Rhineura.*

The basioccipital-exoccipital region bears a transverse dumbbell-like condyle, the two outer knobs being much wider than the median portion. It is presumed that both exoccipitals and basioccipital bones contribute to the condyle. Seen directly from behind the condyle occupies a position about mid-distant between top and bottom and its transverse length equals one third of the greatest width of the brain case. Directly lateral to the condyle knobs and closely approximating them are large nerve foramina.

Seen from the ventral surface, anterior to the condyles are two roughened elevated areas, the outer edges of which lie just below the fenestra ovale. Presumably they mark the original positions of the paroccipital* bones that are now missing. Somewhat farther forward, on the outer edge of the bone are notches marking point of contact with the posterior end of the missing pterygoid. Just anterior to the level of the notches the bone has been broken, but anterior to the break it continues forward, having the appearance of a spearhead. Toward its anterior end a saggittal ridge develops. The anterior part of the bone is absent.

Measurements in mm.—Actual length of fossil, 7.5; estimated skull length, 10; greatest width of brain case (otic region), 4.5; narrowest width at level of posterior point of frontal, 1.5. From highest elevation to foramen magnum, 2.7; from highest point to end of condyle, 4.3; from highest point to the anterior end of parietal, 4.15; to posterior end of parietal 4.1.

Remarks.—The aberrant character of the species *Rhineura minuta* described by Gilmore (Proc. U. S. Nat. Mus., vol. 86, 1938, pp. 12-14, fig. 1) strongly suggests that the relationships might better be shown by regarding it in a genus apart from *Rhineura.* The characters which appear to separate the species from *Rhineura* are those in which *Rhineura* differs from *Gilmoreia.* These are the absence of a wide flaring deflected facial portion, the lesser angle of deflection, the narrow, sharp-edged elevation on the dorsal surface lacking an overhanging edge, the smooth character of the anterior

* In the figure, the legend "PO" is not connected with the paroccipital.

dorsal part of the skull. In consequence there is a probability that *minuta* may eventually prove to be a member of the genus *Gilmorcia.*

The type locality of *G. attenuatus* is also the type locality of two other species of amphisbaenids, *Rhineura minuta* Gilmore and *Rhineura sternbergii* Walker. Since my skull is incomplete and the other two practically complete, many points of comparison are lacking. Based on the skull characters given by Gilmore and the accompanying figures, *Gilmorcia attenuatus* differs from *Rhineura minuta* in being large, estimated length, 10 mm. (7.8 mm.). The greatest width of the brain case 4.5 mm. (3.3 mm.); width at orbits 1.5 mm. (?) (2.9 mm.); least width 1.5 mm. (1.6 mm.). (The measurements of *minuta* in parenthesis.) In *G. attenuatus* the skull seen in lateral profile has the posterior part of the brain case nearly horizontal then it suddenly rises to the highest point then slopes gently (not curves) downward. In profile the dorsal outline of *minuta* seems to curve from the foramen magnum to snout tip, not reaching or forming an angular elevation. The transverse width of the condyle is equal to one third of the total width of the brain case. In *R. minuta* neither the size of the condyle nor its position are given in the description. However, the figure shows the transverse width of the condyle to be one half of the width of the skull and situated lower than in *attenuatus.*

Characters on which the two species agree are, the smooth surface of dorsal elevated part of skull; the narrowness of the elevated skull part; and absence of the overhanging wings of the parietal and frontal.

Compared with *Rhineura sternbergii,* the angle of defflection is less sharp and the depth of the skull at the highest point is seemingly less. The length of the posterior part of skull (highest point to end of condyle) is 4.3 mm.; from highest point to anterior extension of the parietal, 4. 15 mm.; while in *sternbergii* the distances from highest point to condyle end is practically double the extension of the parietal from the highest point forward.

Genus HYPORHINA Baur

Hyporhina Baur, American Naturalist, vol. 27, 1893, pp. 998-999.

Type species.—Hyporhina antiqua Baur.

This genus has been established on the following characters:

A postorbital arch formed by a postorbital bone; prefrontal small excluded from the boundary of orbit by the frontal and maxillary; nostril ventral to snout; four acrodont teeth in each maxillary; pre-

maxillary, nasals and frontals nearly meeting at a point near tip of snout.

A specimen of a small amphisbaenid from the Middle Oligocene of Logan County, Colorado, belongs in this genus. It bears some points of resemblance to, and numerous differences from, *Hyporhina antiqua* from the Middle Oligocene, Washington County, South Dakota. There is a postorbital arch closing the orbit of the eye; and the frontals, nasals, and prefrontals almost meet at a point near the tip of the snout. The contour of the skulls are in general similar; however, the angle of deflection in the Colorado skull is somewhat less than in *Hyporhina antiqua.* The two most significant differences are that the prefrontal bone is much larger than in *Hyporhina antiqua* forming at least one third of the border of the orbit, and there are six pleurodont maxillary teeth on each side, instead of four "acrodont" teeth. The original description does not mention this dental character but Charles W. Gilmore who studied the type says: "The teeth appear to be acrodont."

If the teeth of *Hyporhina* are indeed acrodont one may doubt the wisdom of considering this form with pleurodont teeth as belonging to the same genus. Such a dental character is considered very significant, serving in Lacertilia to distinguish the two lizard families Agamidae and Iguanidae from each other. Until the character of the teeth of *Hyporhina antiqua* can be established as acrodont beyond question, I shall consider the present species as congeneric with *Hyporhina antiqua.*

Hyporhina galbreathi sp. nov.

Plate LVIII, figs. 6, 7, 8; Plate LIX, figs. 4, 5; text figs. 2, 3

Type.—University of Kansas Museum of Natural History, Paleo. No. 8221, consisting of a skull, complete save for the absence of the quadrate and a part of the squamosal. The lower jaw is absent. Collected under the direction of Dr. Claude W. Hibbard, University of Kansas Museum of Natural History Expedition of 1946.

Type locality.—Clyde Ward Ranch, Logan County, Colorado, July 31, 1946.

Horizon.—Middle Oligocene (Orellan), White River Formation.

Diagnosis.—A species, related to *Hyporhina antiqua* Baur, but differing from this form in having two spinelike lateral processes on the anterior part of the parietal (not protruding); in having a much larger prefrontal forming more than one third of the border of the orbit, rather than a small one completely separated from the

orbit; six maxillary teeth present that are definitely pleurodont, rather than four that are regarded as acrodont.

Description of the type.—The skull is diminutive (8.5 mm. long), the frontal portion strongly deflected and wider than the posterior part of the braincase. The premaxilla seen from above has a curved surface, subtriangular in shape, about a third greater in its transverse width than in its length. Posteriorly it is in contact with the

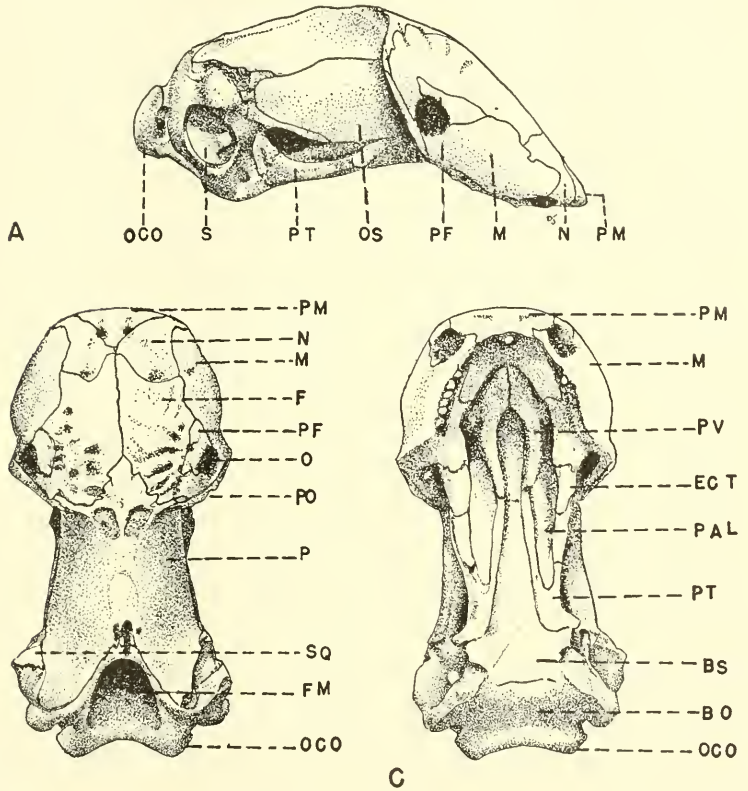

FIG. 2. *Hyporhina galbreathi sp. nov.* Type, Kansas U. Mus. Nat. Hist., Paleontology No. 8221. Oligocene, Orellan, Clyde Ward Ranch, Logan Co., Colorado. Dr. Claude Hibbard and party, collectors, July 31, 1946. A. Lateral view; B. Dorsal view; C. Ventral view. Actual length of fossil 8.5 mm.

nasals. When seen from below, it presents a flattened surface external to the mouth, with two rather shallow diagonal grooves. When seen laterally the snout is rather wedge-shaped. Latero-posteriorly the element is bordered by the external nares, and its edge is notched on each side by the tip of the maxillary process,

which forms the inner rim of the naris. Medially, nearly in a line between the nares but at a different level, is a single tooth arising from the premaxilla within the edge of the buccal cavity. Behind this the premaxilla sends out two divergent processes that pass along the sides of the anterior part of the maxillary tooth rows on a level with the bases of the teeth, and are separated by the anterior part of the prevomers.

On the dorsal surface of the skull the nasals are narrowly in contact mesially, from which point they diverge and pass forward narrowing greatly, then widening somewhat as they turn outward and under the edge of the snout to form the anterior border of the nares. Small foramina are present on the naso-frontal border as well as on the naso-premaxillary border. The paired frontals are large, about twice as long as wide, separated narrowly from the premaxillary, and in contact with each other along a straight median suture for more than half their length. Posteriorly the bones have a lateral process that extends downward to and forms a part of the posterodorsal rim of the orbit. Seemingly they are in contact with the maxillary by a very narrow pointed process posterior to the orbit. The posterior parts of the frontals are heavily sculptured with pits, foramina, and shallow grooves, while the anterior part is shallowly and indistinctly sculptured. The maxillary bone is longer than wide, forming the lower part of the orbit. It folds under the lateral edge of the snout to the alveolar edge and forms a considerable area on the underside of the skull. The teeth are pleurodont in character and are set well back under the bone. There are six maxillary teeth, the largest being the second from the front.

The prefrontal is a small element lying somewhat above and in front of the orbit, and forming more than one third of the border of the orbit. The postfrontal is a slender bone inclosing the orbit and fitting into a notch in the parietal, dorsally, and into a similar notch in the maxillary, ventrally.

The single parietal is an extensive saddle-shaped bone, the anterior triangular part being elevated, and deflected downward slightly. It pushes in between the posterior parts of the frontals. A spinous process is present on each side at a level with the posterior edge of frontal, touching the postorbital bone and bordering the posterior edge of the frontal. At the highest part of the skull there are two symetrical, roughened depressions on the parietal narrowly separated medially, which presumably serve for muscle

attachments. Posteriorly the parietal sends back two broad processes which diverge and reach rather close to the posterior level of the condyle. Laterally the parietal is in contact with the otic region, the squamosal and the orbitosphenoid.*

The supraoccipital seemingly is fused with the exoccipitals the basioccipital, and the bones of the otic capsule, so that none of the individual elements are discrete. The combined element forms the border of the foramen magnum, becoming thicker and more massive on the sides. The posterior rim of the foramen bears the occipital condyle, on each side of which is an articular knob. The exoccipital area of the combined bone is thick and massive, with a forward directed part that is closely joined to the squamosal and lies above the ear opening. The squamosal appears as an "inlay" bone on top of the otic region and is wedged in between the posterior part of the parietal and the orbitosphenoid. A portion of the combined occipital bone (prootic?) appears directly in front of the squamosal.

The orbitosphenoid is a large bone, reaching forward from the squamosal to the anterior edge of the orbital vacuity and forming the cranial wall on the side of the skull. On the floor of the orbital vacuity it is in contact with a section of the frontal.

The stapes covering the fenestra ovalis is oval in shape with a cylindrical columella extending outward and forward. There is no trace apparent of an extracolumellar element, although one may have been present originally.

No trace of the division between the exoccipitals and basioccipital is evident. The latter bone slants forward and downward. The suture between this element and the basisphenoid (parasphenoid of Zangerl) is faintly evident at a point 1.8 mm. anterior to the median depression between the condyles. The basisphenoid is notched laterally at the point where its widest point narrows suddenly to half its width and proceeds forward, the sides converging anteriorly. Here it contacts (passes above) the vomers which extend forward to the median point of the premaxillaries. Two roughened areas on either side of the posterior part of the basisphenoid may represent the position of the missing paroccipitals ("element X" of Zangerl).

The prevomers form a median suture anteriorly for about 1.15 mm. then diverge, the two branches bordering the anterior part of

* The nomenclature of this element may be questioned. Gilmore calls it the alisphenoid but it appears to be more properly the orbitosphenoid, or a combined element. However, there is no evidence that an optic foramen is present.

the parasphenoid (presphenoid?), which is slightly deflected downward and has a median ridge. The prevomers also contact the anterior part of the pterygoids and the palatines laterally. The pterygoids are narrow anteriorly, and extend back, passing to some distance behind the palatines, where each sends up a small lateral process that reaches almost to the stapes. External to the palatines the pterygoids contact the ectopterygoid. The palatines occupy the depressed area between the maxilla and the ectopterygoid on the outside, and the vomerine process and the pterygoid on the inside.

Measurements in mm.—Greatest length, 8.5; greatest width of braincase, 4; greatest width of deflected frontal area, 4.4; narrowest skull width, 2.8; greatest elevation (without lower jaw), 3.8.

Remarks.—As already stated, this specimen differs from the generic description in having more than four teeth on the maxillary, and in having the prefrontal forming a large part of the boundary of the orbit (more than one third). In appearance there is such a striking general similarity in form that I am inclined to place the species in *Hyporhina* at least for the present.

It is generally accepted that the Oreodon (Orellan) beds of the White River formation in northeastern Colorado are older than the Leptauchenia (Whitneyan) beds of South Dakota. It would then appear that this species is older than *Hyporhina antiqua* (if the latter is correctly allocated in time) but it is not at all impossible that the two may be found to occur together since the time separation of the two zones is seemingly not great.

The presumed differences in the character of the teeth of this species and *Hyporhina antiqua* would suggest that a much wider separation between the forms exists than that between species. The living amphisbaenid genera *Trogonophis, Pachycalamus,* and *Agamodon* have acrodont teeth. All are African in distribution. Other living forms presumably have pleurodont teeth.

REFERRED MATERIAL

Among the fossils collected by Mr. Edwin C. Galbreath in the Oligocene of Logan County, Colorado, in 1948, are two other specimens that are here regarded as referable to this species: K. U. M. N. H. P. No. 8222 and No. 8219.

No. 8222: This specimen bears the following data: SW¼ of Sec. 12, T. 11N. R54W., Logan County by E. C. Galbreath (field No. 5850). It consists of a skull that retains only a small part of the deflected facial portion, and the greater part of the right side of

the braincase. The front and outer part has been fragmented recently as the broken edges show but little wear. Of the parts present the following characteristics are discernible (Plate LIX, fig. 4):

Frontals.—Only the posterior parts of these elements are present but these are considerable larger than the deflected facial part of the parietal, partially wedged between them.

The surface sculpturing is similar to the type but differs somewhat in details. On the sides there are two or three grooves terminating in deep pits. No fragments of the prefrontals are in evidence but a portion of the orbital vacuity is overhung by the frontal. This edge has a small rounded notch for contact with the prefrontal. An examination of this area discloses no foramen that might serve as a passageway for an optic nerve.

Parietal.—The parts of the parietal that remain, and particularly the posterior extensions on each side of the foramen magnum, resemble the condition in the type. However, on the right side a small thin squamosal element, lying above the otic-occipital region, is larger than a similar element in the type. Abutting against the lower posterior extension of this element is a quadrate in normal, vertical, functioning position. Immediately posterior to the quadrate is the "stapes" with a broad irregularly oval base covering the fenestra ovalis, and a slender columella rising from it to nearly two thirds of the greatest length of the base. The outer termination of the columella is somewhat expanded and may have supported an extra-columella such as obtains in certain living, as well as in certain extinct, forms. On the median line of the parietal at or near the point at which the bone contacts the supraoccipital there is a rather large perforation,* a character evident or suggested in some other fossil skulls, as well as in skulls of living forms.

The basal portion of the skull, from the basioccipital to a point where the anterior extension of the cranial cavity is exposed in a fracture, is a single element composed of (presumably) the basioccipital, basisphenoid and perhaps also a presphenoid. There is no evidence of a break in its continuity. The superficial membrane bones of the palatine region normally present (the prevomers, pterygoids, ectopterygoids, and palatines) are absent, leaving a broad smooth chondral bone terminating anteriorly in three points, of which the median is on a different plane than the other two. It forms a suture with the frontals. Laterally for a considerable portion of its length, the bone forms a suture (not an overlapping)

* Of this opening Rainer Zangerl (1944) says, "space left by removal of cartilaginous part of the anterior supraoccipital prong."

with the orbitosphenoid. Posterior to the frontal a fragment of the upper part of the postorbital is discernible.

The association of this incomplete skull with the species *H. galbreathi* can scarcely be questioned. Measurements of equivalent parts differ only by fractions of a millimeter. The one exception, already mentioned, is the greater distinctness and apparently larger size of the squamosal. This may be due to a partial fusion in the type of a part of this bone to the underlying chondral elements.

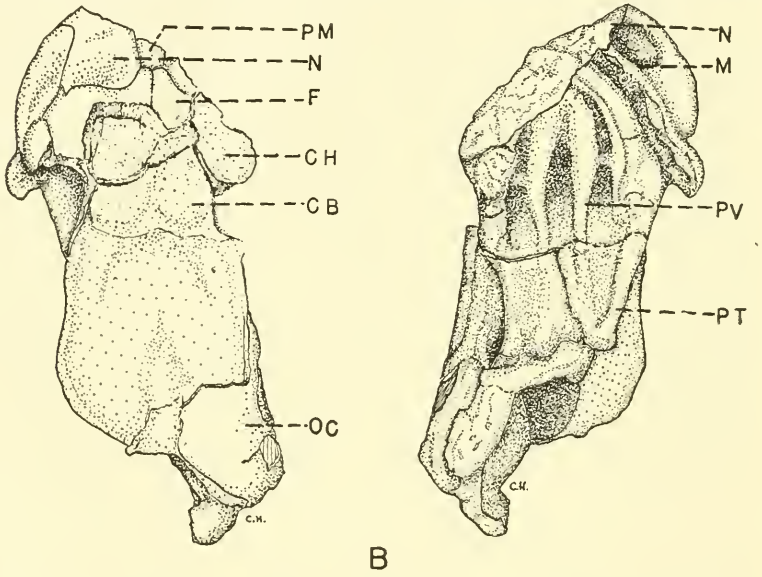

FIG. 3. *Hyporhina galbreathi sp. nov.* (referred material showing part of a cast of the braincase) Kansas U. Mus. Nat. Hist., Paleontology No. 8219. Oligocene, Orellan, Clyde Ward Ranch (SE¼ SW¼ Sec. 12, T. 11N, R. 54W), Logan Co., Colorado. Edwin C. Galbreath, collector. A. Dorsal view; B. Ventral view. Actual length 8.4 mm.

As a result of this the terminal portion of the parietal on either side of the dorsal foramen magnum differs somewhat from the type in contour.

No. 8219: This fragmentary skull taken from the same locality as the previous specimen, is associated with *Hyporhina galbreathi* on the basis of structural similarity of the few elements of the braincase that still remain.

The vomero-palatine region is similar to that of the type save that the posterior palatal prong of the premaxillary is a little longer and slightly more slender. It bears the same general relationship to the premaxillary and maxillary fragment. On the dorsal surface, the

close approximation of the frontals, nasals, and premaxillary to a common medial point obtains, however the premaxillary actually is in contact with the frontals, thus separating the nasals narrowly. A fragment of the postorbital definitely indicates its generic as well as its specific relationship. A bone chip from the dorsal surface, comprising the anterior part of the parietal and the posterior part of the frontals, shows marked similarity of this portion of the skull to this region in the type specimen.

Probably the most significant feature of this specimen is that, due to the removal of much of the roof of the skull, a considerable portion of a cast of the brain is exposed.

In the mesencephalic region a pair of rounded oval corpora bigemina may be distinguished, flanked on either side by the orbital vacuities. This is at the narrowest point of the skull. Immediately following this is a massive area the anterior part of which is trilobulate, and separated from the mesencephalon by sulci. The two outer lobules are relatively narrow; the median broad. Posteriorly, across the middle of this region, there is no trace of lobulation or sulci. Immediately in front of the point of entrance of the foramen magnum there is a broad entrant superficial groove, which lies below a dorsal perforation of the brain case situated on the median line between the parietal and the supraoccipital bones. From this depression a slight epiphysis seems to be present but actually this may be an unnatural accretion of some sort. There is no apparent division into metencephalic and myelencephalic parts.

Anterior to the mesencephalon the cerebral lobes push posteriorly and laterally, terminating immediately in front of the orbital vacuity. This widening of the brain in this region suggests that the telencephalon has somewhat the shape of an arrowhead with the diencephalon and part of the mesencephalon pushing in between the lobes. (Plate LIX, fig. 5).

GENUS RHINEURA Cope

Rhineura Cope, Proc. Acad. Nat. Sci. Phila. 1861, p. 75.

Type species.—Rhineura floridana (Baird).

One living species and six fossil species are recognized.

Rhineura hibbardi sp. nov.

Plate LX, figs. 1, 2, 3; text fig. 4 A, B, C.

Type.—University of Michigan, Museum of Paleontology, no. 25431. Skull with lower jaws; bones on anterior facial portion of skull fragmentary; condyle lacking. Collected by Dr. Claude W. Hibbard and party, August 5, 1947.

Type locality.—Smith Ranch, Logan County, Colorado. Center of Sec. 7, T.11N—R.53W.

Horizon.—Middle Oligocene, White River Formation, Oreodon Zone.

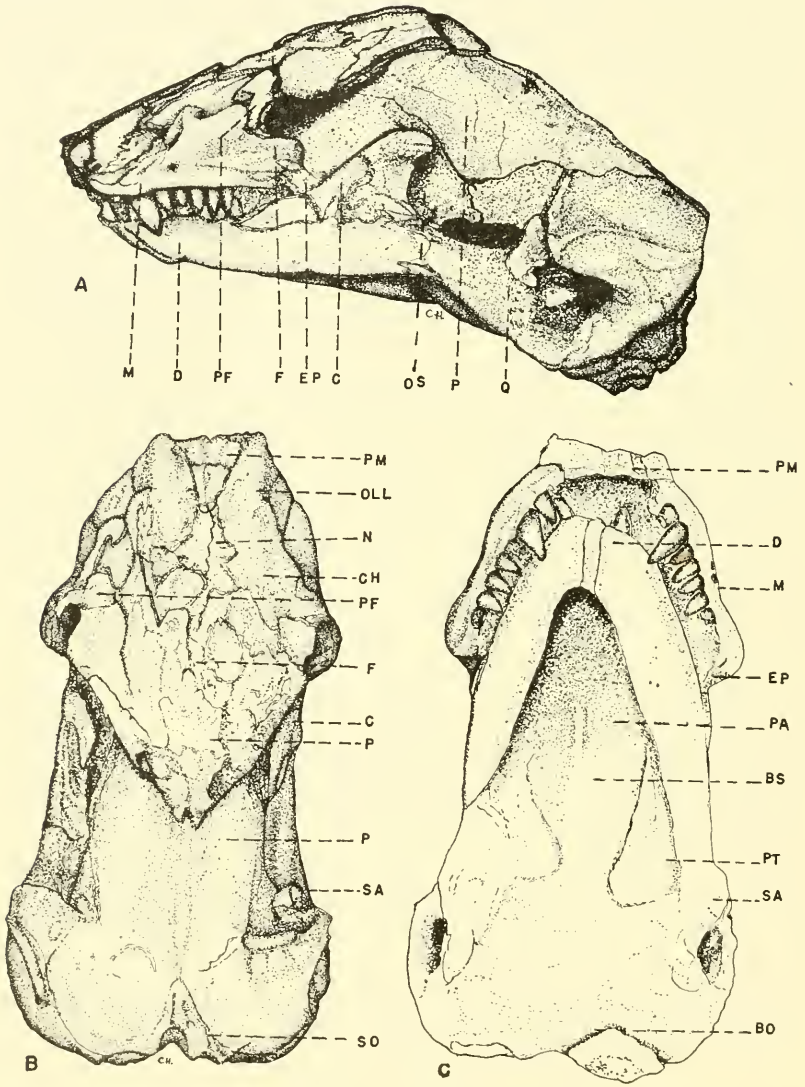

FIG. 4. *Rhinoura hibbardi sp. nov.* Type. Univ. Michigan Mus. Paleo. No. 25431. Oligocene, Orellan, Smith Ranch (center sec. 7, T. 11N, R. 53W), Logan Co., Colorado. Dr. Claude Hibbard and party, collectors, Aug. 5, 1947. A. Lateral view; B. Dorsal view; C. Ventral view. Actual length of fossil 16.6 mm.

Diagnosis.—A large member of the genus *Rhineura,* the skull length reaching approximately 20 mm.; the width of the brain case in the otic region 8 mm.; seven teeth in maxillary, the second largest and somewhat caninelike; seven teeth in dentary, the fourth and first being largest.

Description of the type skull.—The skull at present measures 16.6 mm. from the nasal region to the back of the otic capsule area. The anterior part of the nasals has been largely chipped away, as is true also of most of the premaxilla and the upper parts of the maxillaries; the mold of the brain case appears partially exposed in several places. The olfactory lobes running forward are partially separated by the deeper fragments of the posterior part of the premaxilla, whose suture with the nasals is clearly indicated; the internasal suture can be discerned beginning from the premaxillary, but it can be followed posteriorly for only a short distance. Most of the dorsal surface of the nasals and frontals is missing; however, a few fragments of the frontals display the rugosities and sculpturing typical of the genus *Rhineura.* The outer posterior edge of the frontal overhangs the orbital vacuity for a maximum width of slightly more than two millimeters. The parietal is a saddle-shaped bone, bearing a median sagittal ridge that begins just in front of the foramen magnum, and runs forward and upward for 7 mm. Here the parietal surface becomes suddenly elevated forming a roughened triangular area. Forward of this area the facial part of the skull is deflected abruptly downward. The area of the parietal on this deflected part of the skull consists of a pair of lateral diverging prongs overhanging the orbital vacuities and a forward median extension whose extent cannot be clearly determined. Anterior to the otic capsules the whole brain case is constricted, the parietal extending far down on the sides where it is bordered, anteriorly by the orbitosphenoid and posteriorly by a portion of the occipito-otic complex, that probably corresponds to the prootic. Posteriorly the parietal flairs out but the boundaries with the supraoccipital behind are indistinct and partially broken. For a considerable distance (perhaps half of its entire length) it overlays the bones of the occipital-otic complex. This complex is composed of the supraoccipital, basioccipital, exoccipitals and otic capsules fused seemingly into a single entity, the sutures between the elements being no longer distinguishable. The squamosal is fused solidly to the outer border of the capsule forming a thick overhanging shelf with which the quadrate articulates. The

quadrate is present but has slipped downward exposing its own articular surface. The anterior face of the quadrate rises considerably higher than the articular face, and the whole upper part is normally exposed as a somewhat rounded knob. Covering part of the lower portion of the quadrate is a biscuit-shaped bone, the extracolumella. This bone, seemingly, is not attached; that is, it forms no sutures but is normally held by a ligament from the columella. The fenestra ovalis is large, measuring, on one side of the skull, 2.4 mm. in length, and 2.1 mm. high. The stapes with the columella is missing entirely on the right side, while a portion of the element is present on the left side.

The lower outer face of the maxillaries are more or less complete while the upper surface is chipped away. Five teeth are actually present on the right side with a space between the second and third, and presumably a space following the last, making a total of seven. On the left side there are seven teeth, the first being broken at the base. The second of both series is much enlarged and caninelike. Posteriorly the maxillary joins the ectopterygoid but the actual extent of the suture cannot be traced since the bone itself disappears behind the coronoid. The preoculars lie in front of the orbit and make an undulating suture with the maxillary. They border the whole anterior rim of the orbital vacuities.

Both dentaries are present, each bearing seven teeth of which the fourth is largest. The first tooth of the series is larger than the remaining five. The dentary joins a very large coronoid, which has its beginning anteriorly at the level of the sixth tooth of the dentary series. The greatest length of the coronoid element is more than double its greatest height above the dentary. The dentary and coronoid join the surangular posteriorly, but the details of the sutures are not wholly clear. The surangular bears a notch near its upper center into which the quadrate articulates, while the posterior part of the element bends sharply downward and tends to cover partially the fenestra ovalis.

The basal part of the brain case consists of the basioccipital fused laterally with the exoccipitals, and paroccipitals, and anteriorly with the basisphenoid. The condylar protuberance, save for a small fragment on the left side, is missing. Seen from the ventral surface there is a smooth, relatively deep depression between the points of fusion of the paroccipitals from which point the forward extension of the basal part of the combined element bends downward. A median ridge is evident on the median line; bordering the sides

of the palate (or anterior part of the ventral surface of the brain case) are the pterygoids, which are strongly elevated rather than flat as is the expected position of these bones. Anteriorly they join with the ectopterygoid, and posteriorly they abut against a notch in the side of the basioccipital. Palatines are present as are also the prevomers, but this area of the skull is covered with a hard matrix so most of the significant details cannot be given here.

Measurements in mm.—Estimated length 20. Actual length 16.6 (condyles and tip of snout missing); greatest width of brain case 8.1; least width 4; notch of foramen magnum to point of greatest elevation 7.7; greatest depth of skull and jaws 7.8.

Remarks.—The lateral view of the photograph of the type skull (plate LX, fig. 1) shows the fenestra ovalis, the orbital vacuity, and a point between them intensely black. This is deep shadow only, the skull being intact at these points.

Rhineura amblyceps sp. nov.

Plate LIX, fig. 1; Plate LXI, figs. 1, 2, 3, 4, 5; Plate LXII, figs. 1, 2, 3, 4, 5; text figs. 5 A, B, C., 6 A, B, C.

Type.—University of Kansas Museum of Natural History (Paleo.) No. 7649, consisting of the basal portion of a skull, the anterior facial portion of which, from about the middle of the frontals being entirely absent.

Type locality.—Clyde Ward Ranch, Logan County, Colorado, July 29, 1946.

Horizon.—Middle Oligocene, Orellan, Oreodon Zone.

Diagnosis.—A moderately large species of *Rhineura,* with an estimated total skull length of approximately 18 mm., and the greatest width of the brain case of about 7.7 mm. The orbitosphenoid is separated from the squamosal by a distance more than one half of its length.

Description of the type.—The deflected facial portion of the skull consisting of the posterior parts of the frontals and the anterior part of the parietal, stands at an angle with the dorsal axis of the skull. The sculpturing of the surface is extremely roughened, there being deep pits, grooves, rounded knobs and irregular vermiform elevations. The frontals, incomplete anteriorly, become narrowed somewhat posteriorly, terminating in blunt points. They are separated posteriorly by a triangular forward prolongation of the parietal; the suture between the frontals and parietal being very irregular. The two lateral wings of the anterior part of the parietal form a sinuous suture while the medial part is somewhat dovetailed.

Only after submersion in a clearing fluid can the complete suture be discerned. The portion of the common median frontal suture remaining, measures 3 mm. in length while the greatest length of the remaining parts of the frontal is 4.3 mm. There is no part of the orbit indicated, but the inner part of the orbital vacuity is overhung by the remaining edge of the frontals and the anterior tip of the parietal.

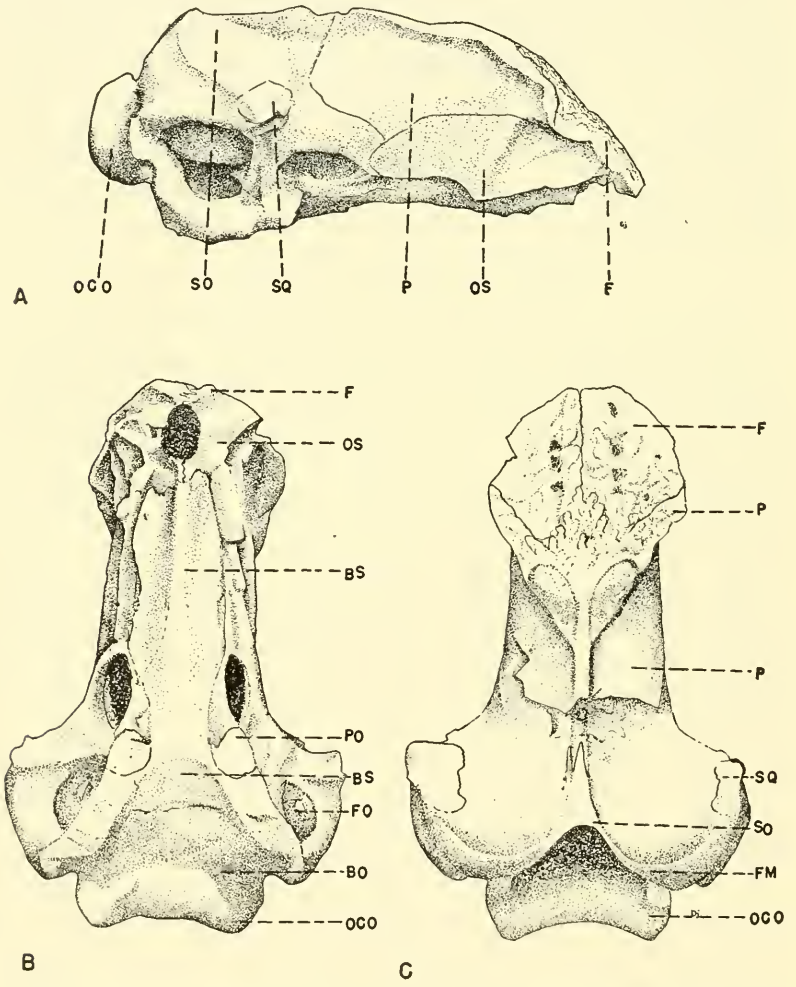

FIG. 5. *Rhineura amblyceps sp. nov.* Type. Kansas Univ. Mus. Nat. Hist. (Paleo.) No. 7469. Oligocene, Orellan, Clyde Ward Ranch, Logan Co., Colorado. Dr. Claude Hibbard and party, collectors, 1946. A. Lateral view; B. Ventral view; C. Dorsal view. Actual length of specimen 12.5 mm.

The parietal is saddle-shaped, flaring broadly posteriorly, bending low on the sides of skull, and reaching forward to the orbital vacuity. The dorsal anterior part is elevated forming an area, triangular in shape with three forward projecting prongs, the two outer are longest and the median widest but shorter than the outer.

There is a median longitudinal ridge beginning near the foramen magnum and running forward to the deflected facial portion of the skull varying in its elevation. In the lower posterior part of the triangular elevated area there are two symmetrical, oval, slightly depressed areas with somewhat roughened surfaces (presumably for attachment of muscles to hold the head at an angle). The posterior extension of the parietal is missing, having been chipped away but there is a depression following the posterior rim of the supraoccipital that seemingly marks its original contours. These form two rounded extensions, separated posteriorly by a median projection from the supraoccipital which dove-tails with the parietal about two millimeters anterior to the forward edge of the foramen magnum. Elsewhere the parietal overlies the combined otic-occipitals, the extent of the overlap at places equaling half the length of the parietal (perhaps more).

The posterior chondrocranial bones of the brain case have fused into a continuous bony complex, composed of the supraoccipital, exoccipitals, basioccipital together with the elements of the otic capsule. On the ventral surface of the brain case the basisphenoid is likewise fused to the combined bone and possibly also a presphenoid (it is presumed that these elements are all distinct in the embryo or young animals). The limits of these various elements is only to be conjectured (save for a remnant of a suture between basioccipital and basisphenoid). (The references to *area* and *region* are based on probable positions of the various elements.) The otic areas are very large and dorsally are surmounted by a thin scalelike bone partially fused, that I regard as the squamosal. The outer edge of this bone is thickened and forms the point of contact for the quadrate (this element is lost in this specimen).

The occipital condyle* is a curved, continuous "roll," with articular lateral knobs or facets. Presumably it is composed of the basioccipital and parts of the exoccipitals. The condyle is elevated strongly leaving the foramen opening almost wholly dorsal, suggesting that the head must be held at an angle for the proper en-

* Since the description was drawn up the skull has suffered certain fractures and the loss of the condyle.

trance of the chord. Anterior to the condyle on the posterior ventral surface, the basioccipital flares out suddenly then narrows gradually to a point in front of the anterior level of the fenestra ovale, where it is notched to receive the posterior ends of the pterygoids; but the sides remain nearly parallel for some distance before the bone terminates in (probably) three points (the tip of this element is missing but the impression is more or less distinct). Anteriorly the bone forms a suture with the orbitosphenoid and along its middle parts with the occipital complex (prootic). Low on the side anterior to the fenestra ovale is a large opening on the side of the skull, bounded above by the prootic and below by the sphenoidal element.

The anterior extension of the cranial cavity is exposed anteriorly. It is surrounded by very heavy bone of the frontal and orbitosphenoid (see text fig. 6, B†).

Measurements in mm. of type.—Total length (estimated) 18; actual length of fossil 12.5; greatest width of braincase 7.7; narrowest width of braincase 3.4.

Referred material.—Univ. Kansas Mus. Nat. Hist. (Paleo.) No. 7650 is referred with doubt to *Rhineura amblyceps*. The braincase is somewhat narrower, and while there are points of resemblance, some differences are discernible. (Plate LXII).

Kansas Univ. Mus. Nat. Hist. (Paleo.) No. 9041. Fragmentary skull. This seems to differ from the other described specimens in having the posterior part of the pterygoids enlarged and much thickened, with a thin, laterally compressed process reaching forward to contact palatine and possibly also the ectopterygoid. A fragment of the lower jaw (surangular) is pushed against the fenestra ovale on the right side. A quadrate is in place, more horizontal than vertical in position (obviously not the normal position). This bone shows some wear. There is no knob-like outer process on its upper forward edge. (Plate LXI).

Michigan Mus. Paleo. No. 25430, Oligocene, Orellan. Red zone and sandstone. Smith pasture, center sec. 7, T.11N, R.53W, Logan Co., Colorado. Actual length 14 mm. (Plate X). Skull, the braincase and facial portion largely complete. This is referred to *Rhineura amblyceps* with some hesitancy. Six teeth are present in the maxillary, the second largest, the last three subequal in size with a suggestion of a diastema between the third and fourth. The lower jaw is fragmentary and two posterior teeth are in place. The quad-

† In this figure the element marked PO (paroccipital) is actually missing. A scar shows its previous position.

rate is nearly vertical and there is a heavy knob-like structure on its upper anterior edge. Running from the lateral floor of the orbital vacuity to the coronoid is an ossified structure suggesting a cylindrical tendon. (Plate LXVII).

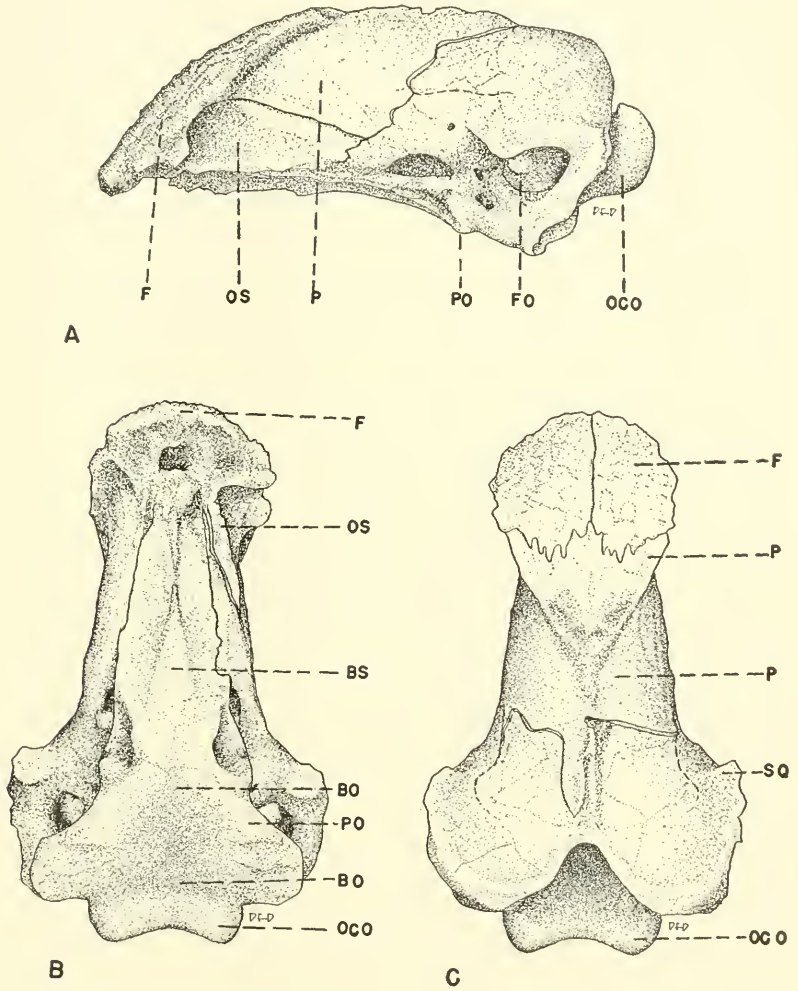

FIG. 6. *Rhinecura amblyceps sp. nov.* Referred specimen. Univ. Kansas Mus. Nat. Hist. (Paleo.) No. 7650. Oligocene, Orellan, Clyde Ward Ranch, Logan Co., Colorado. Dr. Claude Hibbard and party, collectors, July 31, 1946. A. Lateral view; B. Ventral view; C. Dorsal view (relief of sculpturing on frontals not adequately shown). Actual length 11.6 mm.

Rhineura wilsoni sp. nov.

Plate LVIII, figs. 1, 2; Plate LIX, figs. 2, 3; Plate LXIII, figs 1, 2, 3; text fig. 7, A, B, C

Type.—University of Kansas Museum of Natural History, Paleo. No. 7651, consisting of a skull, nearly complete, but lacking squamosal, quadrate, columella, extracolumella, and the entire lower jaws. Collected under the direction of Dr. Claude W. Hibbard, University of Kansas Museum of Natural History Expedition of 1946.

Type locality.—Clyde Ward Ranch, Logan County, Colorado, July 1946.

Horizon.—Middle Oligocene, White River Formation, Oreodon Zone.

Diagnosis.—A species characterized by the small depth of the braincase, elongate prefrontals, and general slenderness of the skull; maxillary teeth 7; nostrils ventral; area lateral to prevomers somewhat inflated. Skull length 14.1. Deflected facial portion of skull practically as wide as greatest posterior width.

Description of the type.—The skull is strongly humped near the middle. The anterior part of the parietal, together with the remainder of the facial portion of the skull being strongly deflected downward. Near the central part of the parietal there is a low sagittal crest developed. This runs forward and terminates at a point where two flattened oval surfaces diverge anteriorly. These two surfaces are presumably points of muscle attachment. These surfaces are slightly depressed but anterior to them the parietal surface becomes very rugose, with pits and grooves, that tend to form a slightly radiating pattern on the frontals. At the posterior end of the sagittal crest of the parietal, the median point is wedged between two points of the forward projecting part of the supraoccipital, which bears a slight median crest. This is flanked laterally by the two broad posterior extensions of the parietals that reach to within one-third millimeter of the superior notch of the foramen magnum; the bones are truncate posteriorly and a part is chipped away but their posterior limit is marked by a low transverse ridge on the supraoccipital. The parietals extend low on the sides of the braincase and form sutures with the prootic and apparently for a very short distance with the orbitosphenoid, and broadly overlies the forward extension of the combined occipital and otic elements which are fused together. The anterior parietal suture with the frontals is intricately dove-tailed with an outer diverging spine that reaches forward perhaps as far as the prefrontal (the edges of the

supraorbital region are chipped and the extent of this element cannot be determined); a prefrontal is present on each side, the anterior part wedged into the maxillary. It is somewhat triangular in shape, however it is likely that portions of the edges of this element are chipped away.

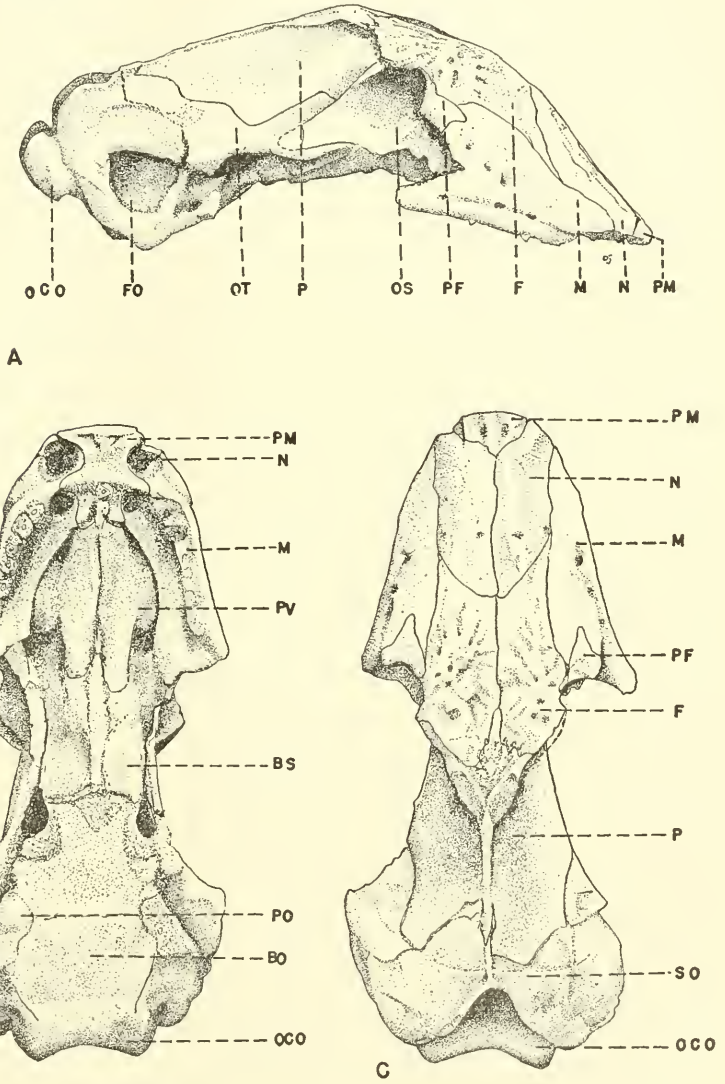

FIG. 7. *Rhineura wilsoni sp. nov.* Type. Kansas Univ. Mus. Nat. Hist. (Paleo.) No. 7649. Oligocene, Orellan, Clyde Ward Ranch, Logan Co., Colorado. Dr. Claude Hibbard and party, collectors, 1946. A. Lateral view; B. Ventral view; C. Dorsal view. Actual length of skull 14.1 mm.

The frontals are once and one half as long as wide, the anterior portions being wedged in between the maxillary and nasals. Nasals are about three times as long as wide, extending to the end of the snout and bending under to form the anterior rim of the nostril. The premaxillary is about $2\frac{1}{2}$ mm. wide on the superior aspect of the snout. On the inferior aspect of snout the premaxillary narrows between the two large nares, but I am uncertain whether they form a part of the rim. Behind nostrils the element widens. The alveolar surface which is more or less directed backward bears a single median tooth. Behind this and on a different level the bone again narrows terminating in two blunt tips in contact with the prevomers.

The maxillary, laterally, rises considerably above the level of the prefrontal and has contact with the prefrontal, frontal and nasal on the superior aspect. Anteriorly a flattened extension of it forms the outer and posterior border of the nostril, and a small curved spinelike projection from it forms most of the inner nostril border. In ventral aspect the maxillary borders the premaxillary, the prevomers anteriorly, and the palatine, ectopterygoid, and apparently also the orbitosphenoid, posteriorly. Three small pits (foramina) are evident on the lateral aspect. A groove or depression passing from nostril is ventral anteriorly, but becomes lateral low on the side. Seen from the ventral aspect the alveolar surface faces slightly inward. Seven teeth are present but only the bases remain, the third and fourth being very much smaller than those preceding or following. A deep pit exists behind the nostril which connects with the groove along the alveolar surface. The broad inner shelf of the maxillary overhangs the outer inflated wings of the prevomers.

The ventral part of the braincase consists of the basioccipital fused laterally with the exoccipitals, paraccipitals, basisphenoid and perhaps a presphenoid. Two lateral notches somewhat in front of the level with the anterior edge of the fenestra ovalis, are for the reception of the posterior extension of the pterygoids. These elements are missing from the skull. It is probable that anteriorly a portion of the palatines remain.

Measurements in mm.—Total length 14.1; greatest width of braincase (through otic region) 6; narrowest width 3.1; greatest width of facial portion of skull 5.8; greatest elevation of braincase 3.7.

Referred material.—A fragmentary specimen, consisting chiefly of a braincase, is referred to this species with doubt. It is Univ. of Michigan Museum of Paleontology No. 25429, Oligocene, Orellan, from Smith Ranch, center sec. 7, T.11N, R.53W, Logan Co., Colo-

rado. It appears to approach *Rhineura wilsoni* closer than it does the other species, and in spite of certain differences, I believe this association the wisest disposition until more material of the forms are available. (Plate LVIII, figs. 1-2; Plate LIX, figs. 2, 3).

Rhineura hatcheri Baur

Plate LXIV, figs. 1, 2, 3; Plate LXV, figs. 1, 2, 3; Plate LXVI; figs 1, 2, 3; text fig. 8

Rhineura hatcheri Baur, Amer. Naturalist, vol. 27, 1893, p. 998, (Type, Princeton University No. 11389, Battle Draw Spring, Washington Co., South Dakota, Leptauchenia Zone); Cope, Rep. U. S. Nat. Mus. 1898 (1900), p. 684; Hay, Bull. U. S. Geol. Surv. No. 179, 1902, p. 476; Eigenmann, Proc. Washington Acad. Sci., vol. 4, Sept. 30, 1902, pp. 533-548, pls. 32-34; Douglass, Annal. Carnegie Mus., vol. 4, nos. 3 & 4, Apr. 1, 1908, pp. 283-284, text figs. 3-5; Nopcsa, Beit. Pal. Geol. Oester.-Ung., vol. 21, 1908, p. 46; Eigenmann, Carnegie Inst. Washington Pub. 104, 1909, p. 48; O'Harra, South Dakota School of Mines, Bull No. 9, p. 121, fig. 20; *ibid.* No. 13, 1920, p. 160; Zittel, and Broili-Schlosser, Gründzüge der Paleontologie, 4 ed., vol. 2, 1923, p. 257, fig. 360; Gilmore, Mem. Nat. Acad. Sci., vol. 22, 3rd memoir, 1928, pp. 35-42, pl. 1, text figs. 17-19; Proc. U. S. Nat. Mus., vol. 86, p. 15, fig. 3; Gilmore and Jepsen, Journ. Paleontology, vol. 19, No. 1, Jan. 1945, p. 31.

This fossil species has had detailed treatment by Gilmore, 1928. I have not had opportunity to examine the referred material, but accept Gilmore's reference of two specimens to the Oreodon beds, Badland Creek, Sioux Co., Nebraska (Carnegie Mus. Nos. 423B and 423C); and one in the Lower Oreodon beds, White River, Oligocene, Cedar Draw, Cheyenne R., Washington Co., S. Dak. (Amer. Mus. Nat. Hist. No. 12226). Whether the faunas of these two places are of identical age as the Orellan of Logan Co., Colorado, remains to be proved. However, it is generally believed that there is no very considerable time interval involved between the three faunas.

In the material at hand I find certain skulls that appear to be referable to the species *Rhineura hatcheri* judging by the published descriptions and figures. These are discussed below.

Univ. Colorado Mus. No. 19852. Cedar Creek phase, White River, Orellan (Middle of west half, sec. 7, T.11N, R.53W, 1½ miles NE of Ward Ranch, 35 miles NW of Sterling, Logan Co., Colo.). This skull is one of the most complete skulls I have examined. Moreover, certain of the chondral bones of the braincase still have sutures evident. Both lower jaws are in place, attached by their respective quadrates, that on the right side has the posterior part of the surangular absent. On the left side the protruding portion of the stapes is missing and the extracolumella is lost from both sides. A portion of the premaxilla has been chipped away.

The nasals are 3.2 mm. long and 1.2 mm. wide anteriorly. A short median posterior projection of the premaxilla tends to separate them anteriorly. The bones show little or no sculpturing or pitting.

The frontals, however, are heavily sculptured on their outer parts with numerous pits (and foramina) while more mesially they show some transverse grooves connecting with pits. They form dovetailed sutures with the anterior part of the parietal along their posterior

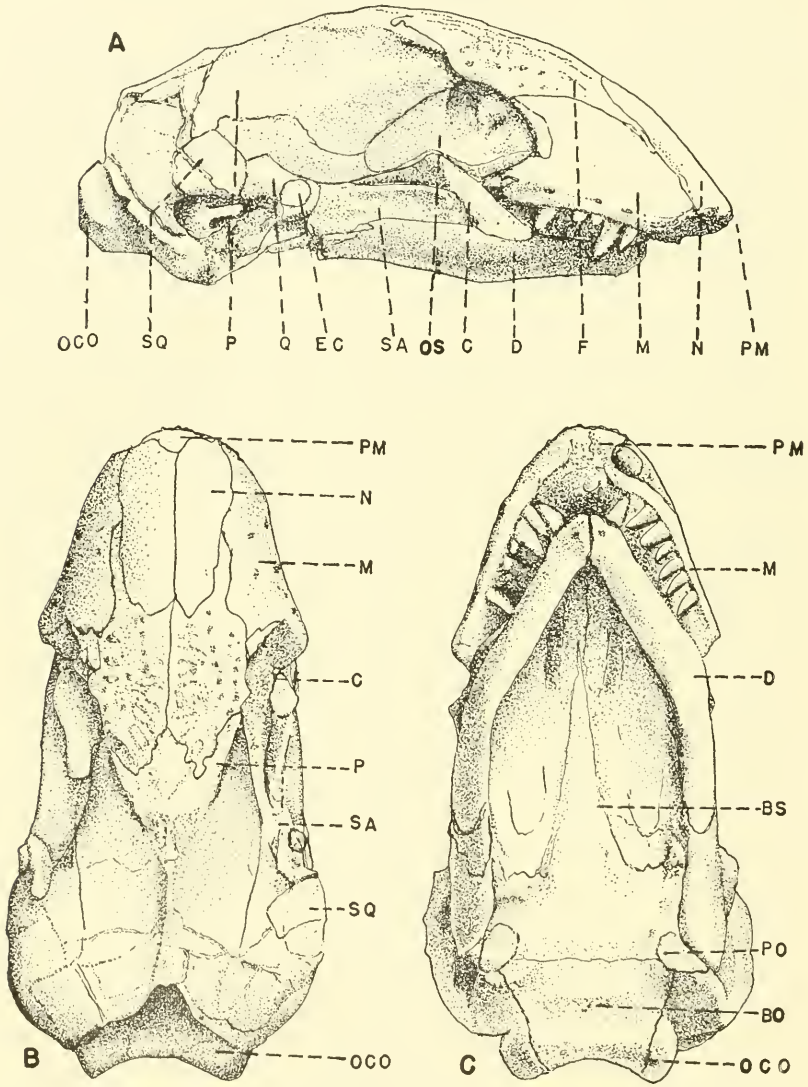

FIG. 8. *Rhinoura hatcherii* Baur. Univ. of Colorado Mus. No. 19852. Oligocene, Orellan (Cedar Creek phase), middle of west half Sec. 7, T. 11N, R. 53W, 1½mi. NE of Ward's Ranch, 35 mi. NW Sterling, Logan Co., Colorado. Dr. Robert Wilson, collector. A. Lateral view; B. Dorsal view; C. Ventral view. Actual length of skull 12.2 mm.

borders. A median anterior parietal projection separates the posterior ends of the frontals. Laterally the frontal overhangs the orbital vacuity above its middle and forms a narrow lateral suture with the prefrontal, and an elongate one with the maxillary; anteriorly an elongate spine projects forward from each frontal separating the nasals, for half their length, from the maxillary.

The parietal is very large, saddle-shaped, with a median sagittal crest (somewhat chipped away) from the anterior border of the dorsal notch of the foramen magnum, and terminating where the elevated portion begins to widen into a roughened triangular area (presumably for muscle attachment). From the anterior edge of this area the facial portion of the skull is deflected downward at an angle. The anterior part of the parietal has a median projection and two lateral arms that extend along the outer edge of the dorsal deflected part of the skull, reaching forward to near the edge of the orbital vacuity. Laterally the anterior part of the parietal reaches to the orbital vacuity. Low on the sides the parietal contacts two bones, the orbitosphenoid anteriorly and the prootic posteriorly. The posterior extension of the parietal is chipped away on both sides but a depression over the otic region suggests that the original limits of the element approached near to the border of the foramen magnum.

The supraoccipital dovetails mesially with the parietal, and on each side the two wings extend forward and laterally, bordering the foramen posteriorly. Normally it is largely covered by the parietal. Laterally the supraoccipital forms sutures with the prootic and the exoccipital.

The exoccipital is clearly defined above the suture, being evident on the left side of the skull (chipped away on the right side). It borders the foramen magnum and extends back to form the outer knob of the condyle, while a projection from the lower part forms the posterior rim of the fenestra ovalis. Its relationship to the region of the fenestra ovalis is not clearly defined. A deep foramen is evident at the lateral base of the condyle. Two of the semicircular canals can be dimly discerned through the transparent bone as whitish stripes. Lying on the anterior part of the exoccipital is a superficial flake of bone, the squamosal, forming a lateral projection for the articulation of the quadrate. The basioccipital is clearly defined on the ventral surface, its sides narrowing and forming the median portion of the occipital condyle. Anteriorly on the ventral surface it forms a suture with the basisphenoid and laterally

with the exoccipital. At the juncture of the three bones is a small, somewhat elongate paroccipital forming the posterior ventral rim of the fenestra ovalis.

The basisphenoid extends forward along the mesial ventral part of the skull, forming sutures with the posterior part of the pterygoids and overlaid by the latter bones and the palatines save for a narrow median pointed part which disappears under the prevomers. I cannot be certain that a separate presphenoid is present. Anteriorly on the palate are the prevomers, the wings of which are not noticeably inflated.

The premaxillary is chipped away but on the ventral portion a single tooth is evident, the base only remaining. The nostrils are ventral, the dorsal rims being formed by the premaxillary, while a spine from the maxillary forms most of the lower edge of the nostril.

The maxillary on the facial surface has a maximum width of 2.1 mm. and a total length of approximately 4 mm. An irregular row of four pits appears near its lower edge, and two or three are present near the middle of its lateral surface. Six teeth are present on the alevolar surface, the second being largest. There is no appreciable diastema in the series. At the posterior end of the maxillary the ectopterygoid is present connecting pterygoid and maxillary.

The dentary is approximately 6 mm. in length, its greatest elevation being about 1.2 mm. It bears seven teeth, the first and fourth being largest. From its dorsal edge arises a coronoid, its base having a length of 1.5 mm. and an elevation of 2 mm. It forms a suture with the inner surface of the surangular. The surangular is elongate extending for nearly half its length behind the articulating fossae. I do not discern a splenial or an angulare since the inner surface of the jaws cannot be seen, as the fossil is now prepared. The quadrate is approaching a vertical position, its width at the fossae being 1 mm., the lower edge rounded; and its greatest length 2 mm., the upper part being divided into a broad surface articulating with the squamosal and a small prong which lies against the prootic. The surface directed toward the fenestra ovale is strongly excavated. The stapes, present on the right side, is an irregular oval with a median columellar prong 1 mm. long, directed forward.

Measurements in mm.—Total length of skull (approximately) 12.6; total length of fossil 12.1; greatest width of brain case 6; greatest width of facial portion 5; greatest depth of skull 4.1. (See plate LXIV, figs. 1, 2, 3.)

Remarks.—The description of this young specimen (regarded as young because of the lack of co-ossification of the chondral bones of the brain case) differs in no significant feature from the descriptions of the type and the figures given by Gilmore (1928). The smaller size of this specimen would seem to indicate an age difference.

I am also referring to the species two other skulls from the same general locality. Univ. of Kansas Nat. Hist. Mus. Paleo. No. 8220 (Plate LXV). The skull has been broken across the middle and the posterior parts are crushed somewhat. The parietal is more complete than in the preceding specimen and extends farther back covering the sutures between the supra- and exoccipital bones. The posterior section of the surangular is present on each side making contact with the quadrate. An extra-columella is present on both sides, closely applied to the posterior excavation (notch) of the quadrate. The sutures between the basioccipital and basisphenoid are present and the tripartite character of the condyle can be discerned. The maxillary teeth are 6-6, the second largest, the fifth a little larger than the adjoining teeth. The measurements approximate very closely those given for the preceding skull.

Univ of Kansas Nat. Hist. Mus. Paleo. No. 8960. Skull nearly complete but with the posterior part of the braincase flattened. The jaws are present, the posterior parts (surangular) being pushed in, covering largely the fenestra ovalis. Sutures between the chondral bones of the braincase can be discerned on the ventral side of the skull, those separating paroccipitals, exoccipitals, basioccipital and parisphenoid being distinct even on the condyle.

The maxillary bears seven teeth and there are seven teeth on the dentary. However, the maxillary teeth seem anomalous. The second upper tooth is largest and is followed by a pair of minute teeth occupying space that would suffice for a tooth of normal size. The last three teeth are subequal, the sixth being a trifle the larger. In the lower jaw there are only six teeth actually present, but a tooth is lost. On the right side the first and third (fourth) are enlarged but a tooth is missing (presumably) behind the first; posterior to the second large tooth there are three subequal teeth, equally spaced. On the left jaw the first and fourth are largest, the two intervening teeth being present. Behind the fourth there is a narrow diastema scarcely large enough to permit a tooth as large as the two posterior of the series. (Plate LXVI.)

The skulls referred to *Rhineura hatcheri* all agree in having the condyle placed close to the lower level of the skull (See text figure

8 this paper; and Gilmore 1928, pl. 1, figs. 2 and 3). This allows the foramen magnum opportunity to face posteriorly more than in certain other species where the condyle is elevated and the foramen magnum is largely dorsal. It would appear that the head of *R. hatcheri* was held less elevated for direct entrance of the spinal chord, than in these species (*amblyceps et al.*).

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(NOTE.—The plates are incorrectly numbered. The plate explanation for plate 14, applies to plate 15, and *vice versa.*)

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PLATE LVIII

FIG. 1. *?Rhineura wilsoni sp. nov.* Referred materials Univ. Michigan Mus. Paleontology No. 25429. Oligocene, Orellan, Smith Ranch, center sec. 7, T. 11N, R. 53W, Logan Co., Colorado. Dr. Claude Hibbard and party, Aug. 5, 1947. Ventral view. Actual length of fossil, 13 mm.

FIG. 2. Same. Dorsal view.

FIG. 3. *Gilmoreia attenuatus sp. nov.* Type. U. S. Nat. Mus. No. 16308. Oligocene, Orellan (Brule), 8 mi. N Douglas, Converse Co., Wyoming. G. P. Sternberg, collector. Dorsal view. Actual length of fossil 7.5 mm.

FIG. 4. Same. Lateral view.

FIG. 5. Same. Ventral view.

FIG. 6. *Hyporhina galbreathi sp. nov.* Type. Kansas U. Mus. Nat. Hist. (Paleo.) No. 8221. Oligocene, Orellan, Clyde Ward Ranch, Logan Co., Colorado. Dr. Claude Hibbard and party, collectors. Ventral view. Actual length of fossil 8.5 mm.

FIG. 7. Same. Lateral view.

FIG. 8. Same. Dorsal view.

PLATE LVIII

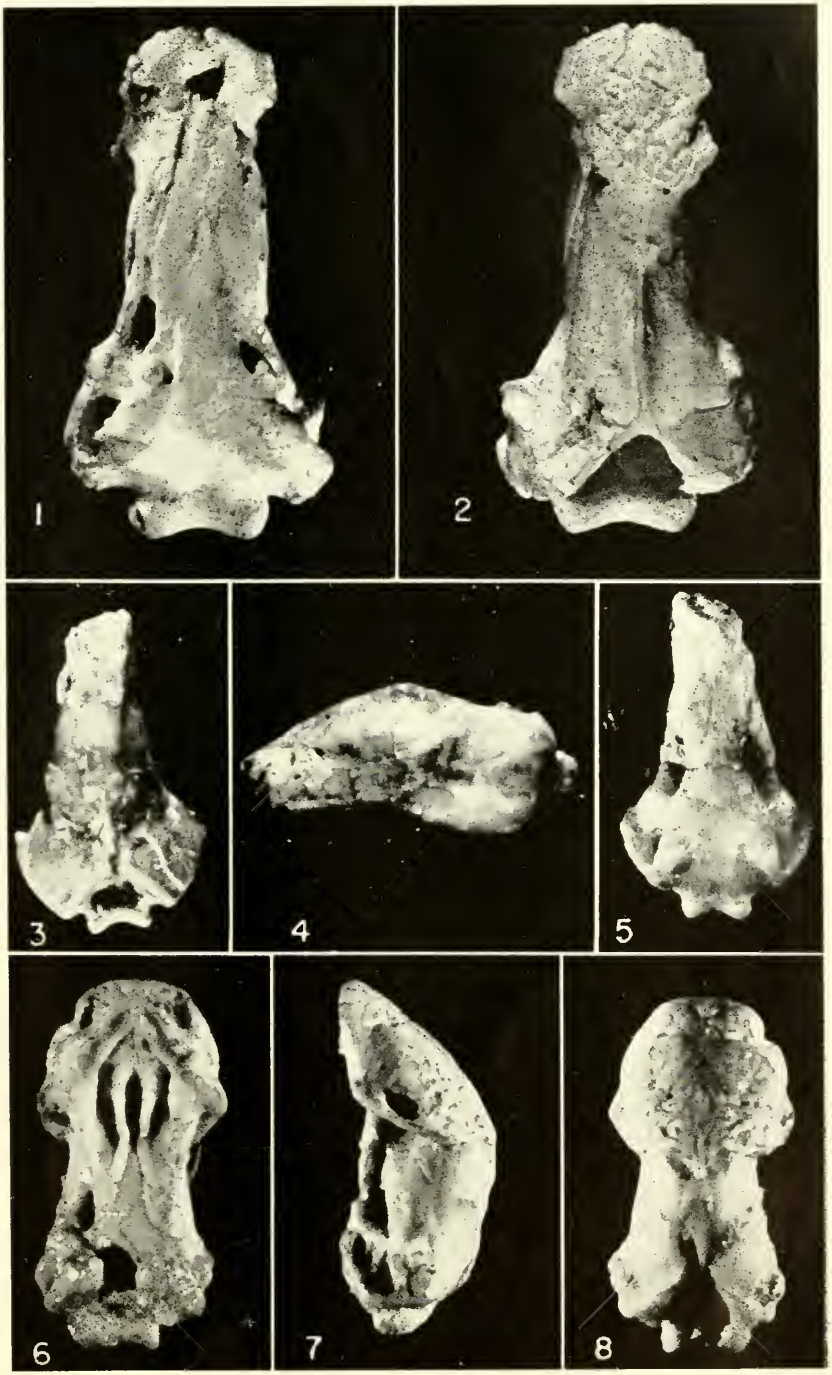

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PLATE LIX

FIG. 1. *?Rhineura amblyceps sp. nov.* (Referred material) Kansas U. Mus. Nat. Hist. No. 9041. Oligocene, Orellan, Clyde Ward Ranch (W½ sec. 7, T. 11N, R. 53W), Logan Co., Colorado. Edwin C. Galbreath, collector, 1948 Lateral view. Actual length of fossil 10.6 mm.

FIG. 2. *?Rhineura wilsoni sp. nov.* (Referred material). Univ. Michigan Mus. Paleo. No. 25429. Oligocene, Orellan, Smith Ranch (center sec. 7, T. 11N, R. 53W), Logan Co., Colorado, Dr. Claude Hibbard and party, collectors, Aug. 5, 1947. Lateral view. Actual length of fossil 12 mm.

FIG. 3. Same. Ventral view.

FIG. 4. *Hyporhina galbreathi sp. nov.* (Referred material). Kansas U. Mus. Nat. Hist. (Paleo.) No. 8222. Oligocene, Orellan, Clyde Ward Ranch, SE¼, SW¼, S. 12, T. 11N, R. 54W, Logan Co., Colorado. Edwin C. Galbreath, Collector. Dorsal view. Actual length of fossil 6 mm.

FIG. 5. *Hyporhina galbreathi sp. nov.* (Referred material). Kansas U. Mus. Nat. Hist. (Paleo.) No. 8219. Oligocene, Orellan, Clyde Ward Ranch, SE¼, SW¼, S. 12, T. 11N, R. 54W, Logan Co., Colorado. Edwin C. Galbreath, collector, 1948. Dorsal view. Actual length of fossil 8.4 mm.

PLATE LIX

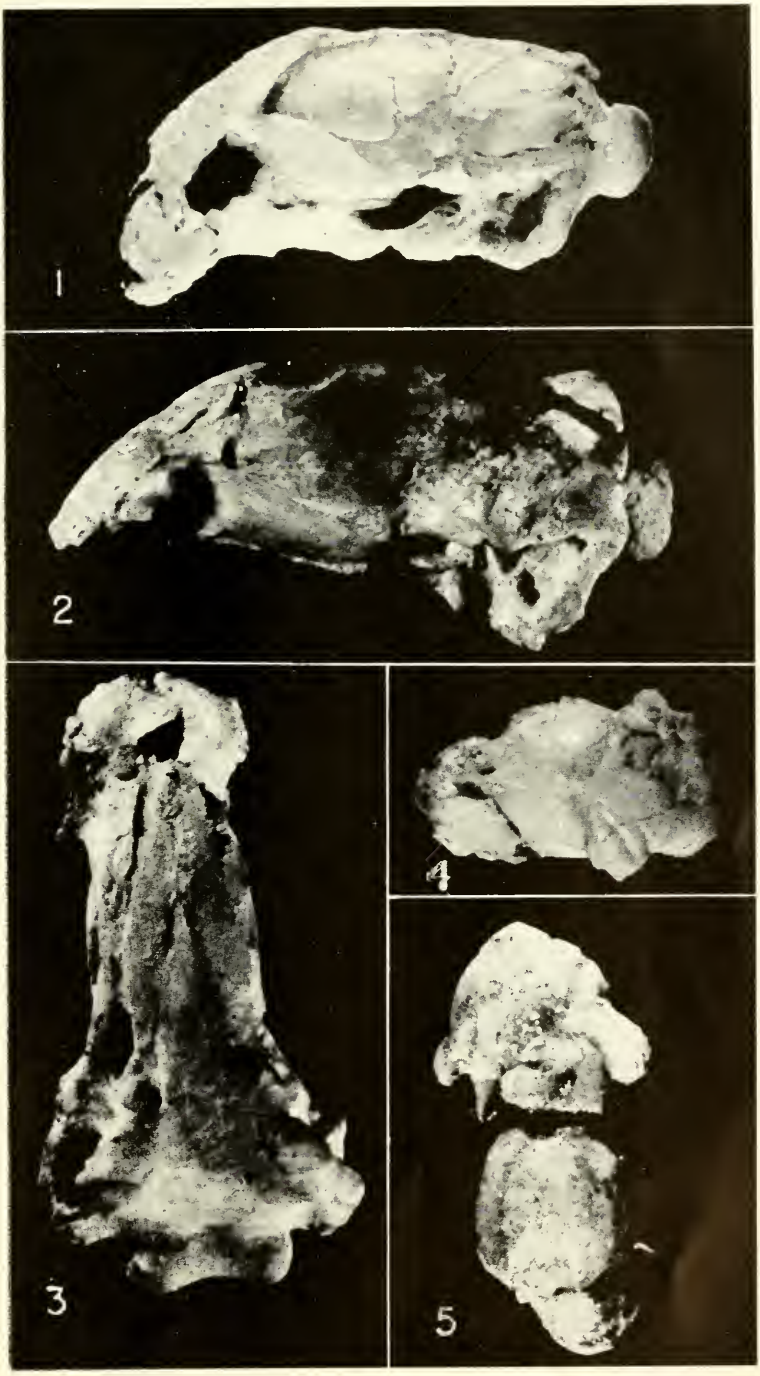

PLATE LX

FIG. 1. *Rhineura hibbardi sp. nov.* Type. Univ. Michigan Mus. Paleo. No. 25431. Oligocene, Orellan, Smith Ranch (center sec. 7, T. 11N, R. 53W), Logan Co., Colorado. Dr. Claude Hibbard and party, collectors, 1947. Lateral view. Actual length of fossil 16.6 mm.

FIG. 2. Same. Dorsal view.

FIG. 3. Same. Ventral view.

PLATE LX

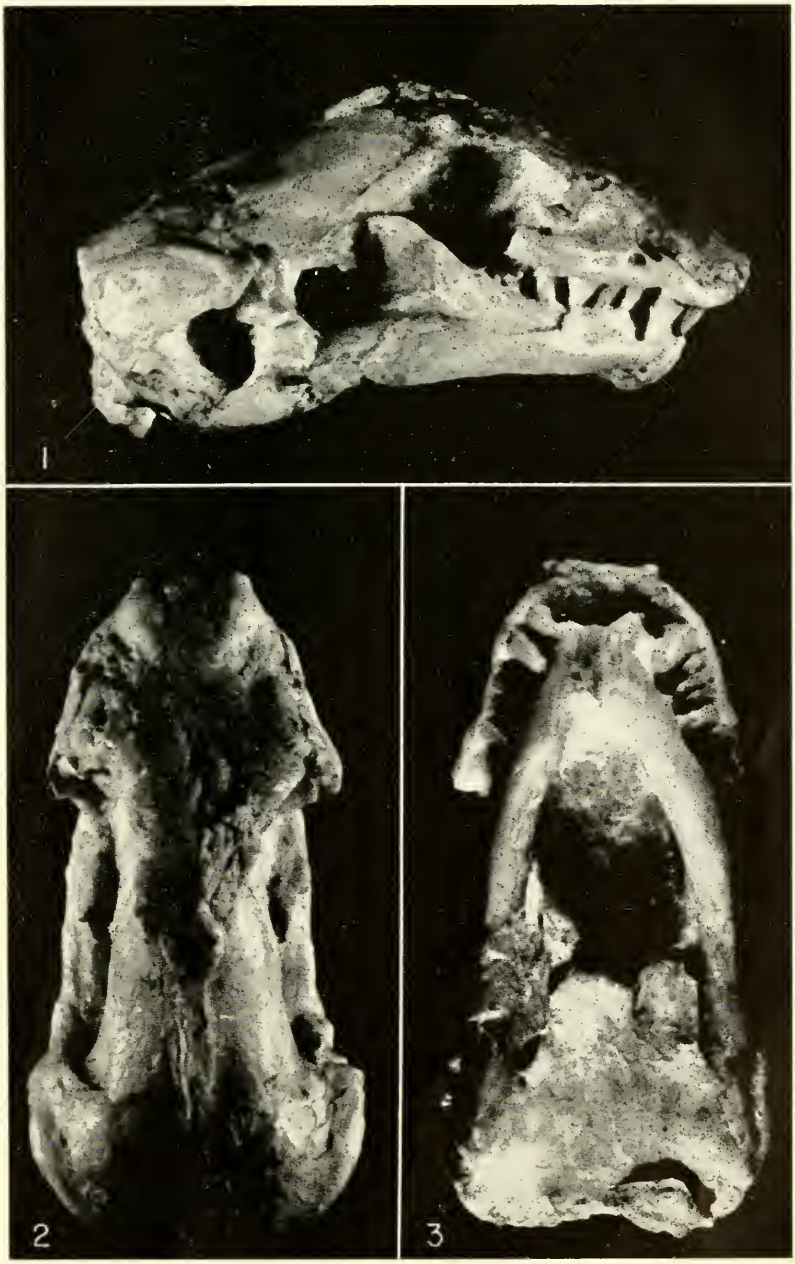

PLATE LXI

FIG. 1. *Rhineura amblyceps sp. nov.* Type. Kansas Univ. Mus. Nat. Hist. (Paleo.) No. 7649. Oligocene, Orellan, Clyde Ward Ranch, Logan Co., Colorado. Dr. Claude Hibbard and party, collectors, 1946. Lateral view. Actual length of fossil 11 mm.

FIG. 2. Same. Ventral view.

FIG. 3. Same. Dorsal view (note figure in text drawn before loss of condyle).

FIG. 4. *?Rhineura amblyceps sp. nov.* (Referred material) Kansas U. Mus. Nat. Hist. No. 9041. Oligocene, Orellan. Clyde Ward Ranch (W½ sec. 7, T. 11N, R. 53W), Logan Co., Colorado. Edwin C. Galbreath, collector, 1948. Ventral view. Actual length of fossil 10.6 mm.

FIG. 5. Same. Dorsal view.

PLATE LXI

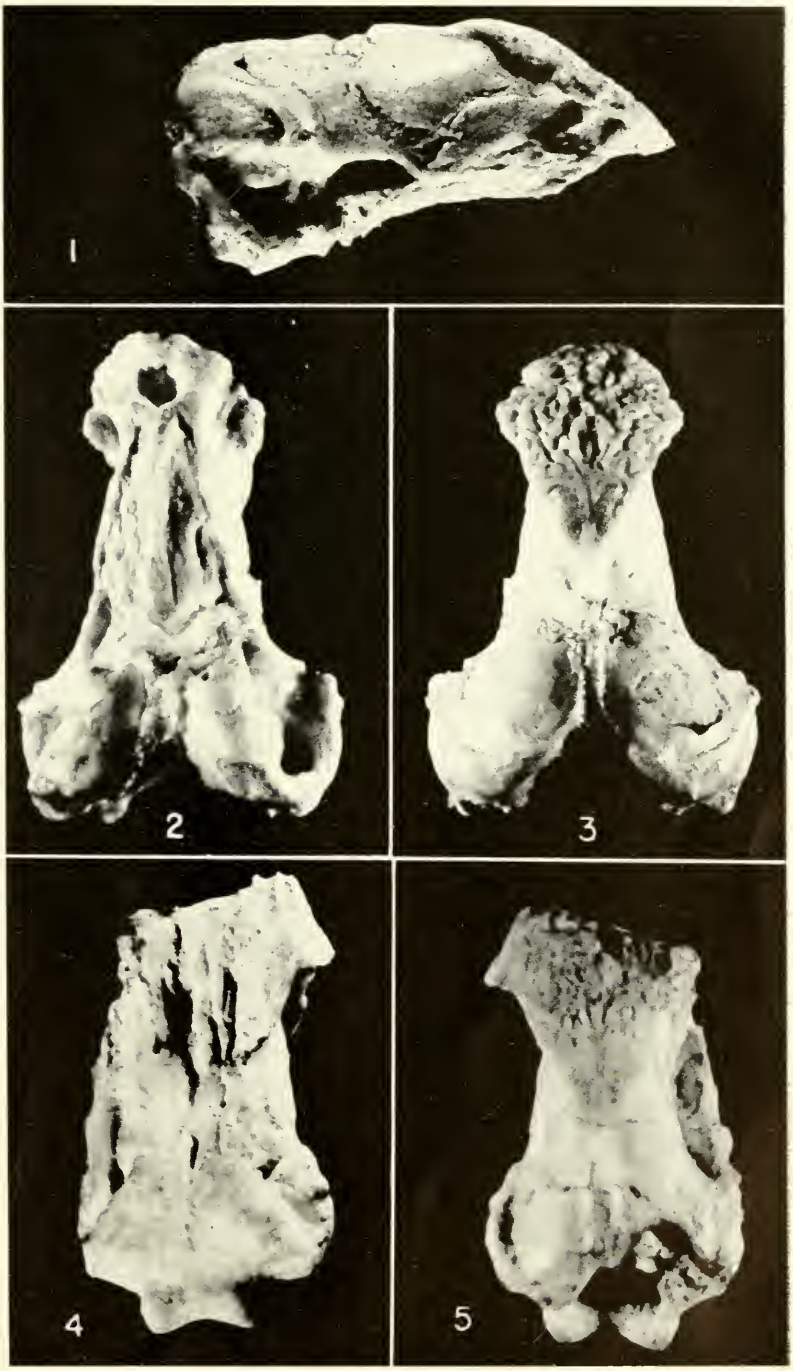

PLATE LXII

FIG. 1. *Rhineura amblyceps sp. nov.* (Referred material) Kansas Univ. Mus. Nat. Hist. (Paleo.) No. 7650. Oligocene, White River (Orellan), Logan Co., Colorado. Dr. Claude Hibbard and party, collectors, July 31, 1946. Lateral view of skull, actual length 12.1 mm.

FIG. 2. Same. Ventral view of skull.

FIG. 3. Same. Dorsal view.

PLATE LXII

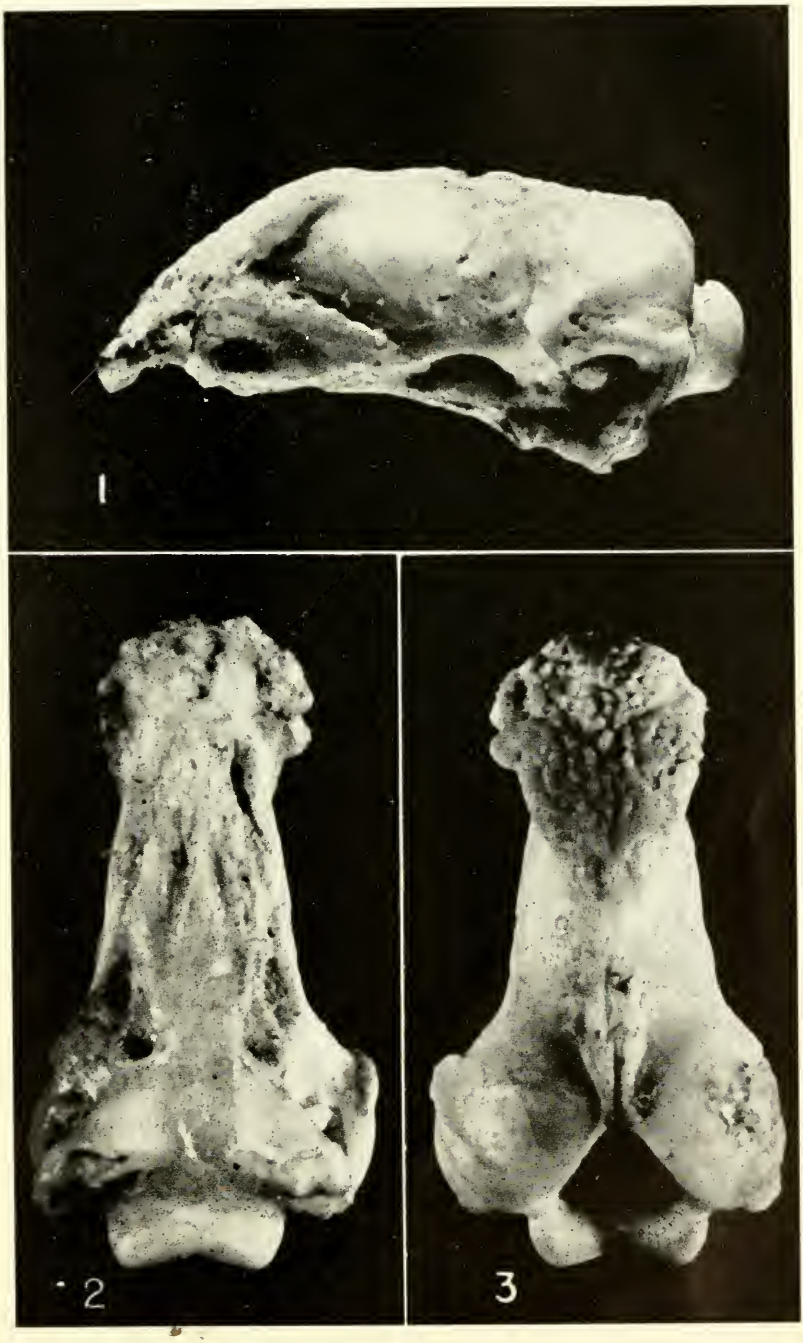

PLATE LXIII

FIG. 1. *Rhinoura wilsoni sp. nov.* Type. Kansas Univ. Mus. Nat. Hist. (Paleo.) No. 7649. Oligocene, Orellan, Clyde Ward Ranch, Logan Co., Colorado. Dr. Claude Hibbard and party, collectors, 1946. Lateral view. Actual length of skull 14.1 mm.

FIG. 2. Same. Ventral view.

FIG. 3. Same. Dorsal view.

PLATE LXIII

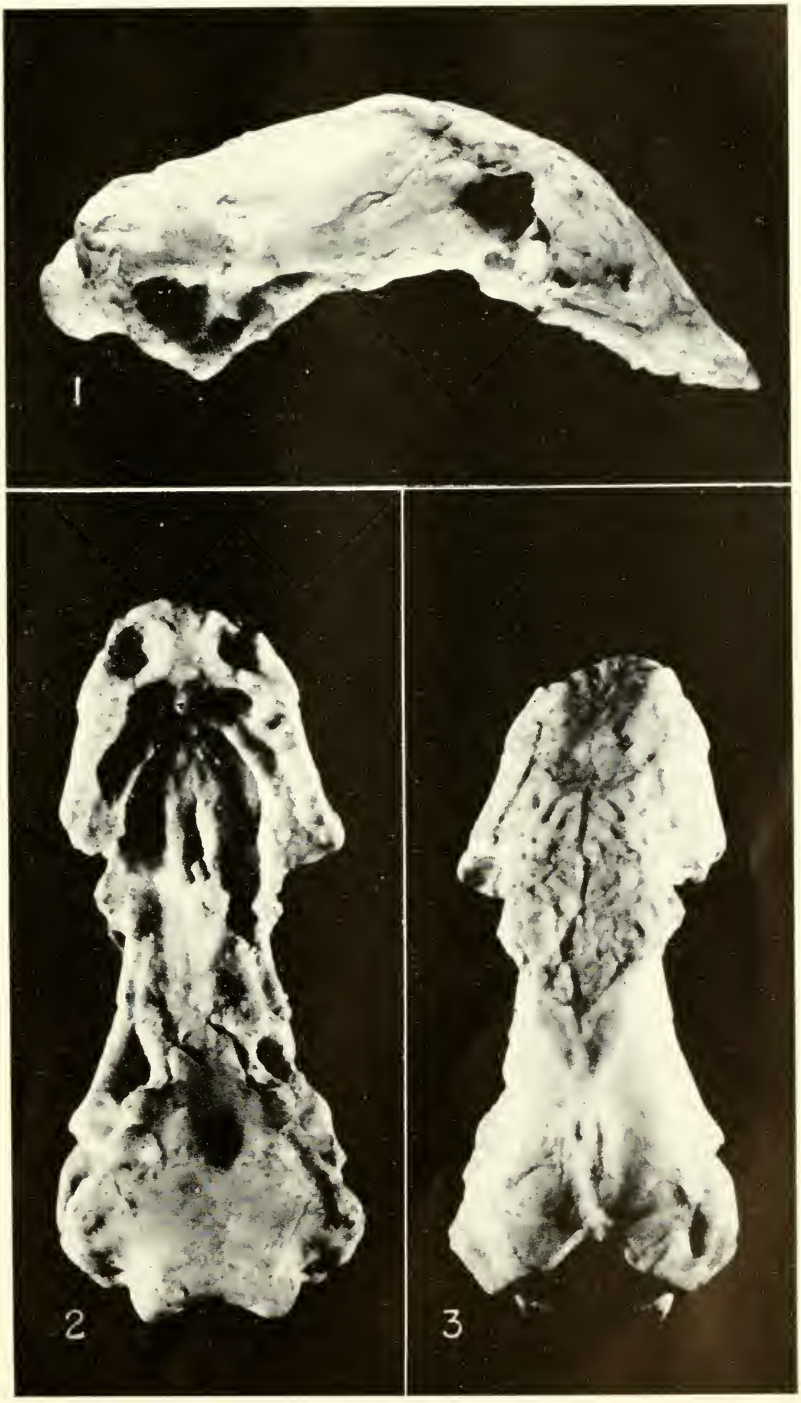

PLATE LXIV

FIG. 1. *Rhineura hatcherii* Baur. (Referred material) Univ. of Colorado Museum (Paleo.) No. 19852. Oligocene, White River (Orellan), Cedar Creek Phase; middle of west half sec. 7, T. 11N, R. 53W, 1½ miles NE of Clyde Ward Ranch, 35 miles NW of Sterling, Logan Co., Colorado. Dr. Robert Wilson, collector, 1940. Lateral view of skull. Actual length of fossil 12.1 mm.

FIG. 2. Same. Ventral view of skull.

FIG. 3. Same. Dorsal view of skull.

PLATE LXIV

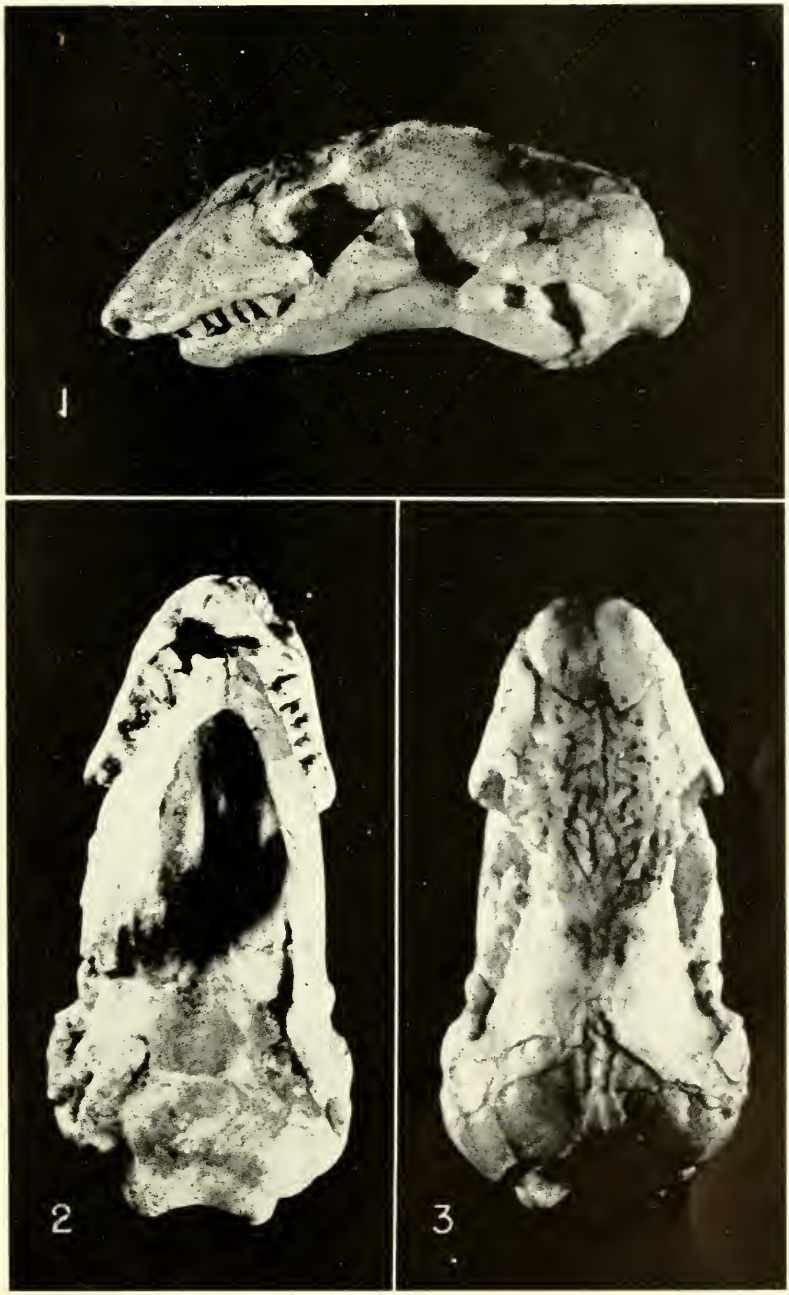

PLATE LXV

FIG. 1. *Rhinoura hatcherii* Baur. (Referred material) Kansas Univ. Mus. Nat. Hist. (Paleo.) No. 8220. Oligocene, Orellan. SE¼, S. 21, T. 11N, R. 53W. Logan Co., Colorado. Edwin C. Galbreath, collector, 1948. Lateral view of skull. Actual length of fossil 12.2 mm.

FIG. 2. Same. Ventral view of skull.

FIG. 3. Same. Dorsal view of skull.

PLATE LXV

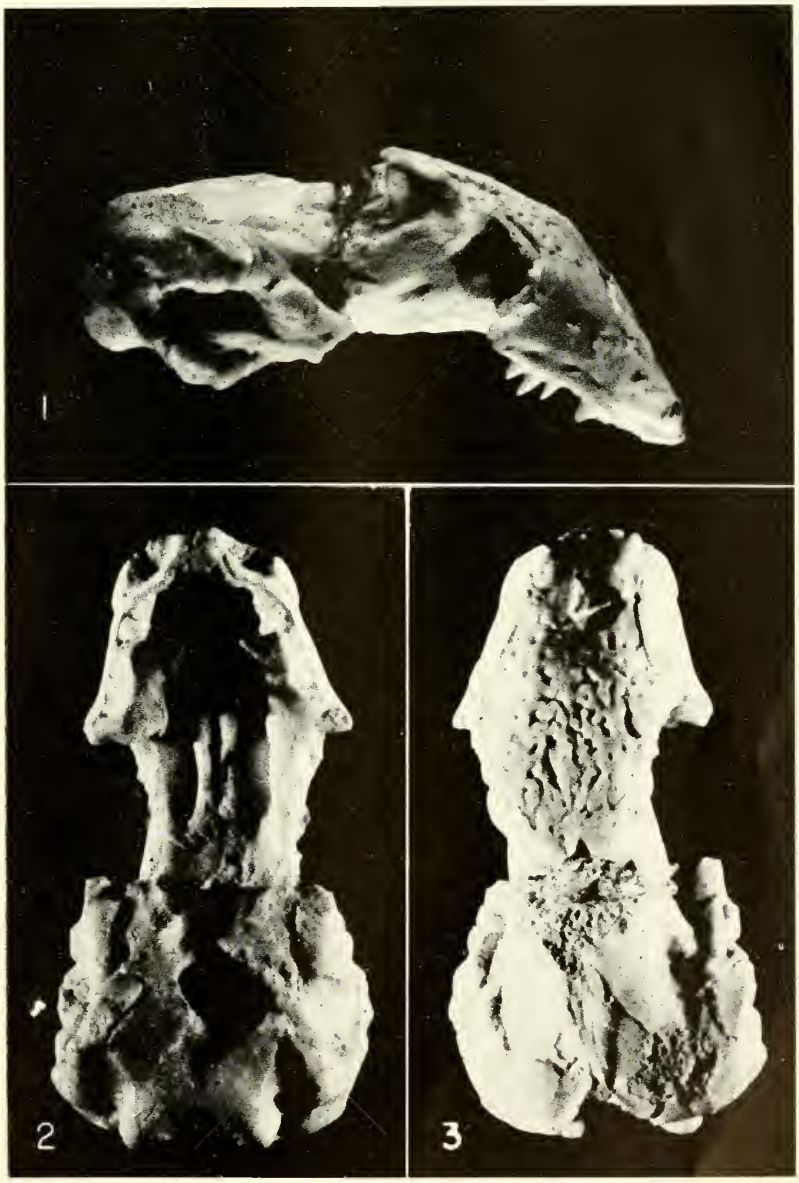

PLATE LXVI

FIG. 1. *Rhineura hatcherii* Baur. (Referred material) Kansas Univ. Mus. Nat. Hist. (Paleo.) No. 8960. Oligocene, Orellan. SE¼, S. 3, T. 11N, R. 54W, Logan Co., Colorado. Edwin C. Galbreath, collector, 1949. Lateral view of skull. Actual length of fossil 12.2 mm.

FIG. 2. Same. Ventral view of skull.

FIG. 3. Same. Dorsal view of skull.

PLATE LXVI

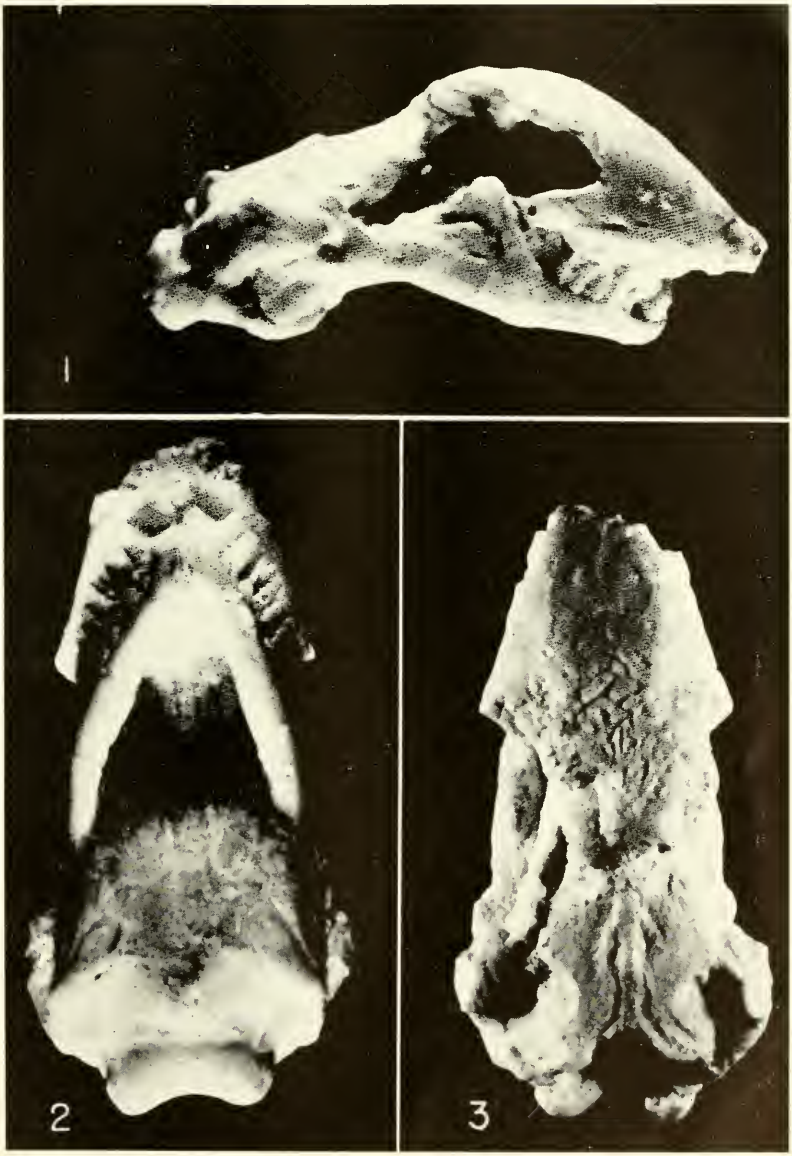

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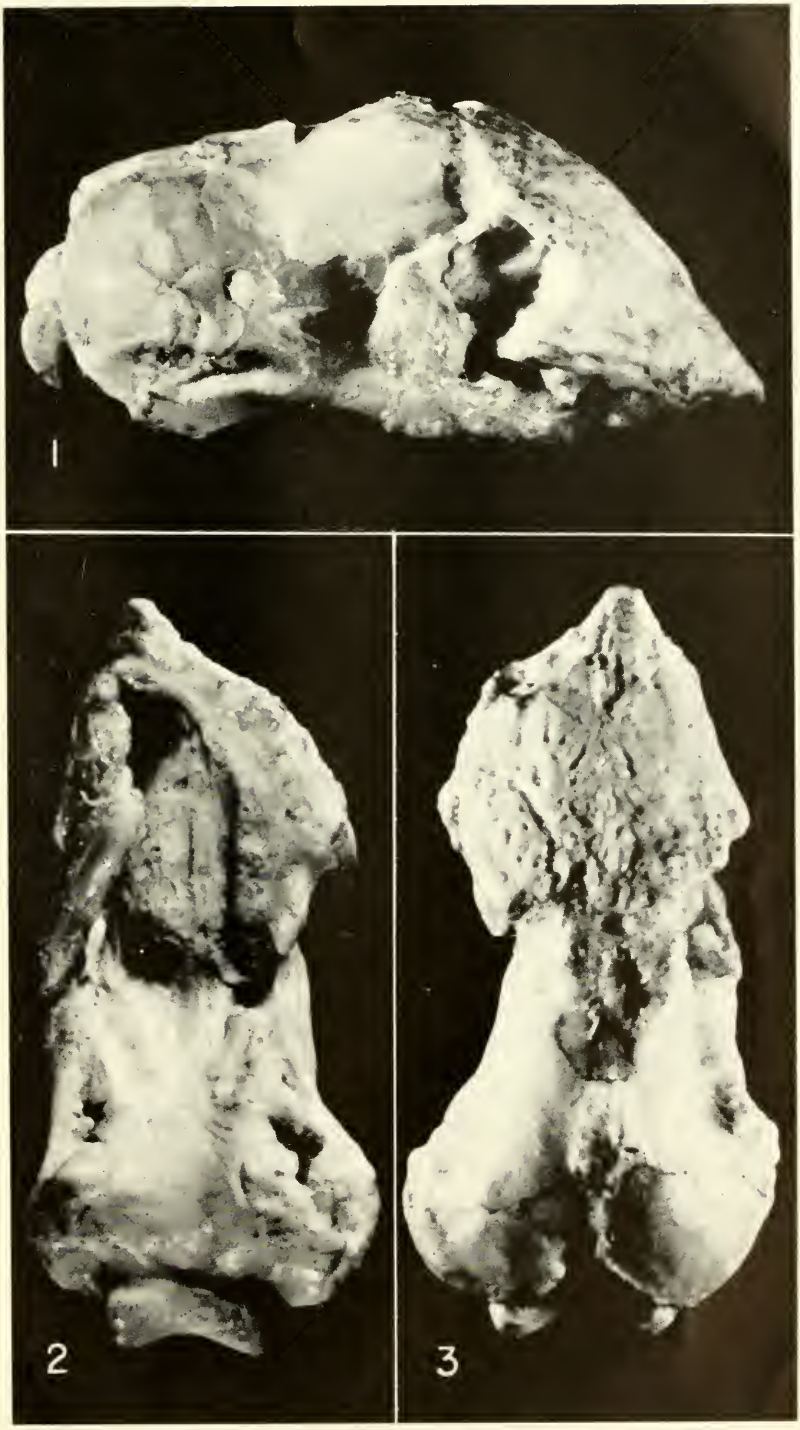
PLATE LXVII

FIG. 1. *?Rhinoura amblyceps.* (Referred material) Univ. Michigan Mus. Paleontology No. 25430. Oligocene, Orellan (Brule), Red zone and Sandstone. Smith pasture, center sec. 7, T. 11N, R. 53W, Logan Co., Colorado. Dr. Claude Hibbard and party, collectors, Aug. 6, 1947. Lateral view of skull. Actual length of fossil 14 mm.

FIG. 2. Same. Ventral view of skull.

FIG. 3. Same. Dorsal view of skull.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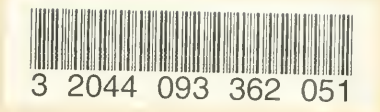
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